A REVISION OF THE HOLARCTIC GENUS *DIKRANEURA* (HOMOPTERA : CICADELLIDAE)

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CONTENTS

SYNOPSIS

The genus is redefined and distinguished from the closely related European genus *Erythria*. A review of all previous work on the genus is presented. The twenty-seven known species and five new species are described. Two major groups of species are recognized, the larger being found throughout the United States, Canada and the Palaearctic region, and the smaller being confined mainly to Mexico and the southwestern United States. Evidence for a Palaearctic origin of the genus, followed by a southerly movement through North America, is considered.

INTRODUCTION

The genus *Dikraneura* Hardy is Holarctic in distribution, the majority of the species occurring in the Nearctic region. Although variously considered in the past by both American and European workers, such treatments have been confined to the Nearctic or Palaearctic region respectively, with little or no attempt to consider the genus throughout its entire range. This restricted approach has had its most deleterious effects on the understanding of the relationships of the European species which, without a consideration of the large number of species present in the New World fauna, have been incorrectly associated. The present paper is an attempt to correct this shortcoming and to arrive at a clearer definition and understanding of the genus.

The genus *Dikraneura* was first described by Hardy (1850*a*) for his species *variata* from the British Isles. Later, Walsh (1862*a*), in the United States, described the genus *Chloroneura*. Shortly afterwards, Fieber (1866*a*) described the genera *Notus* and *Erythria* from Europe which he later, in a catalogue of the European Homoptera (1872*a*), considered to be synonymous. Douglas (1875*b*), in a treatment of the British species, was the first to call attention to the relationship of Fieber's genera to *Dikraneura* when he placed *Notus* as a synonym of the latter and for the next twenty years both *Notus* and *Erythria* were accepted as synonyms of Hardy's genus

in both Europe and the United States. During this period, new species were described from the British Isles (Douglas & Scott, 1876*a*; Edwards, 1885*a*; Buckton, 1891*d*), France (Rey, 1891*a*), Switzerland (de Carlini, 1887*a*) and the United States (Gillette, 1895*a*; Gillette & Baker, 1895*a*). Puton (1875*a*) in a catalogue of the European Hemiptera, referring erroneously to the genus as *Notus*, split it into two subgenera, *Erythria* and *Notus*, with *Dikraneura* as a synonym of the latter. In his later catalogue of the Palaearctic Hemiptera Puton (1886*b*) corrected this mistake by giving Hardy's name its rightful position as senior synonym. He retained his previous division of the genus, with *Notus* as a synonym of the nominate subgenus, and listed twenty-three species for the genus in this region. Van Duzee (1894*a*), in a catalogue of the Jassoidea of North America, listed only two species for that continent, neither of which were present in Europe.

Melichar (1896*a*), in a study of the Homoptera of middle Europe, raised *Erythria* once more to the level of genus with *Notus* remaining as a synonym of *Dikraneura*, a concept that was accepted by the vast majority of workers throughout Europe for the next forty years. Gillette (1898*a*) gave the first revision of the genus for the United States, rejecting Melichar's interpretation of the genus and retaining *Erythria* as a synonym. He described ten species for the genus including six new species. Puton (1899*a*) and Oshanin (1906*a* and 1907*a*) in catalogues of the Palaearctic Hemiptera, listed twenty-two species for the genus, this number being increased to twenty-four by Oshanin (1912*a*) in his later catalogue of the Palaearctic Hemiptera. New species were described in 1897 from Austria (Then, 1897*a*) and in 1900 from Siberia (Melichar, 1900*a*). A few years later, Baker (1903*c*) described four new species from Nicaragua which he considered to be congeneric with the European genus *Erythria* and the first indication of its presence in the New World. He followed the current European concept in viewing the genus as distinct from *Dikraneura* on the basis of general body shape. Two new species of *Dikraneura* were described from Australia (Kirkaldy, 1906*c*) and additional species were also added to the Palaearctic list from Germany (Haupt, 1912*a*) and Sachalin (Matsumura, 1911*b*). A new species was also described in 1914 from the United States (Van Duzee, 1914*a*). Van Duzee (1916*a*, 1917*b*), in revised catalogues of the Hemiptera of America north of Mexico, now listed twelve species for that continent, following the European concept of that time and listing *Notus*, on both occasions, as a synonym. Myers (1923*a*) described a new species from New Zealand and in 1924 additional species were described from the United States (DeLong, 1924*a* and McAtee, 1924*a*). The following year Ball & DeLong (1925*a*) published a further revision of the genus in North America in which they transferred three species, together with two new species, to a new genus *Alconeura* on the basis of the third apical cell of the fore wing. They described fourteen species for the genus *Dikraneura*, including three new species, and followed Van Duzee's 1917 catalogue in placing *Notus* as its synonym.

The Neotropical fauna was first studied by McAtee (1926*b*), who listed twelve species for the genus from that region, including descriptions of six new species. He relegated Ball & DeLong's genus *Alconeura* to a subgenus of *Dikraneura*, subdividing the latter into five subgenera, *Dikraneura*, *Notus*, *Alconeura*, *Kahaona* and a new subgenus *Hyloidea*, on the basis of the venation of the fore wings and the shape of

the head. Two years later, Osborn (1928*a*), in a study of the Neotropical Homoptera of the Carnegie Museum, re-instated *Alconeura* as a distinct genus, an action followed by all subsequent workers. He divided *Dikraneura* into only two subgenera, *Dikraneura* and *Hyloidea*, and described eighteen new species in the former and twelve new species in the latter. He also described another new species from Ohio (Osborn, 1928*b*). A closely related new genus, *Liguropia*, with only one included species, was described from Italy in 1930 by Haupt (1930*a*) and in the same year Lawson (1930*e*) described eight new species of *Dikraneura* from North America. A further species of *Dikraneura* was described in 1934 from North America by Beamer (1934*b*) and an additional two species from the United States in 1936 (Beamer, 1936*a*). Osborn (1935*a*), in a study of the insects of Puerto Rico and the Virgin Islands, described another new species of *Dikraneura*, following his earlier (Osborn, 1928*a*) paper by subdividing the genus into the subgenera *Dikraneura* and *Hyloidea*. DeLong & Caldwell (1936*a*), using characters in the genital plates of the males, separated off and described for the United States a new genus *Forcipata*.

Ribaut (1936*b*), in his classic work on the French Homoptera, studied the group in that country from the point of view of the male internal genitalia, which had not previously been used to any great extent by taxonomists. He revised the earlier concepts of the genus and placed *Erythria* once more, together with *Liguropia*, as synonyms of *Dikraneura*, elevating *Notus* to the level of genus. He described two new species from France and arranged the eighteen included species into seven groups on the basis of the male genitalia, one of the groups being equivalent to DeLong & Caldwell's genus *Forcipata* in America. This new interpretation of the relationship between *Dikraneura*, *Erythria* and *Notus* displaced the earlier one proposed initially by Melichar (1896*a*) and has been followed since then by the majority of workers in Europe and later (Oman, 1949*a*; Young, 1952*b*) in America. At about the same time, DeLong & Caldwell (1937*a*) presented a third revision of the genus for North America, basing their studies likewise on the male internal genitalia. Unlike Ribaut however, they retained *Notus* as a synonym of *Dikraneura*, which they divided into three subgenera, *Dikraneura*, *Notus* and a new subgenus *Curta*. They elevated *Hyloidea* for the first time to the level of genus, comparable to *Alconeura* and *Forcipata*, separating all four genera on the basis of shape, venation and external male genitalia. They described thirty-three species for *Dikraneura* in North America, including twelve new species. Later, in their check-list of America north of Mexico (DeLong & Caldwell, 1937*c*) they listed thirty-five species. In the same year, Oman (1937*d*) described two new species from Puerto Rico and in the following year Cerutti (1938*a*) described a further one from Switzerland. Lindberg (1941*b*) described a new species from the Azores in 1941 and in 1943 Beamer (1943*b*) described twelve new species from the United States, a further one being added by him in 1945 (Beamer, 1945). In a further check-list of America north of Mexico, DeLong & Knull (1945) listed fifty species for the genus at that time. As an indication of the cosmopolitan nature of the genus as then understood, Metcalf (1946) gave the total number of species as seventy-seven, with thirty-six Nearctic, fourteen Palaearctic, thirteen Neotropical, eleven Caribbean, two Australian and one Maorian. Oman (1947*b*), after a consideration of DeLong & Caldwell's subgenus *Curta*, placed it as a

synonym of the subgenus *Notus* Fieber, which at that time was still considered in America to be synonymous with *Dikraneura*. It was not until two years later that Oman (1949*a*), in a generic classification and check-list of Nearctic leafhoppers, elevated *Notus*, for the first time in the United States, to the rank of genus, thereby bringing the American species in line with the European concepts put forward by Ribaut. In this same work he split the genus *Dikraneura* into three genera, *Dikraneura* itself plus the new genera *Kunzeana* and *Dikrella*, on the basis of the relative length of the fourth apical cell of the fore wing, and thereby reduced the number of North American species to twenty-five. Beirne (1952*b*), in a study of the leafhoppers of western Canada, described two new species from that area while Caldwell & Martorell (1952*a*) in the same year, reverting to Osborn's (1928*a*, 1935*a*) concept of the genus as divided into the subgenera *Dikraneura* and *Hyloidea*, described four new species from Puerto Rico.

The first attempt to review the entire range of species in the Americas was made by Young (1952*b*) in his reclassification of the Western Hemisphere Typhlocybinae. Using previously neglected characters of the male internal genitalia and the basal veins of the hind wings, he split the genus *Dikraneura*, as hitherto conceived, into several new genera, thereby producing a more realistic concept of Hardy's genus, which was consequently found to be confined in that hemisphere to North America and Mexico. He listed eighteen species for the New World, dividing them between two subgenera, *Dikraneura* and a new subgenus *Delongia*, the latter containing only a single species differing from the majority by the shape of the male connective and minor variations in both the fore and hind wing. Like Oman (1949*a*), he followed Ribaut in considering *Notus* as a distinct genus and transferred DeLong & Caldwell's subgenus *Curta* as its synonym as indicated earlier by Oman (1947*b* and 1949*a*). McAtee's subgenus *Hyloidea* was relegated once more from the level of genus, to which it had been raised by DeLong & Caldwell (1937*a*), and transferred by Young to *Alconeura* as a subgenus of the latter. The species described from Central America as *Erythria* by Baker (1903*c*) were found to be other than Fieber's genus, which apparently does not occur in the western Hemisphere. Since Young's paper, additional species have been described from Mexico (Ruppel & DeLong, 1953*e*; Borland, 1955*a*) and Siberia (Linnavuori, 1953*a*).

Two common emendations of the name appear throughout the literature. Douglas (1875*b*) emended the name of the genus to *Dicranoneura* and referred to it by this name in his subsequent papers (Douglas & Scott, 1876*a*; Douglas, 1879*a*, *b*). Edwards (1885*a*) was the only worker to accept this emendation as correct and even he discarded its use in his later works (Edwards, 1888*d*, 1890, 1896*b*, 1908). It appears infrequently in the literature, as a synonym of *Dikraneura* (Puton, 1875*a*; Van Duzee, 1917*b*; Schulze, Kükenthal & Heider, 1928*b*; Ribaut, 1936*b*; Neave, 1939*b*; China, 1943*a*, 1950*a*; Kloet & Hincks, 1945*a*) or clearly considered as an erroneous emendation (McAtee, 1918*a*, 1934*a*; Oman, 1949*a*). Evans (1947*a*) mistakenly assumed that Douglas intended a new genus when he first used the name *Dicranoneura* and consequently selected *Cicadula citrinella* Zett., an originally included species, as the type. That this was not Douglas' intention is clearly indicated by the fact that in his first and subsequent use of the name he gives *Dikraneura*

Hardy, 1850, and *Notus* Fieber, 1865, as synonyms and includes *variata* in the list of species. He also states (1879*b*)

> " The genus *Dicranoneura*, or, as Hardy imperfectly wrote it, " *Dikraneura* ", appears not to be accepted on the continent, vice *Notus* Fieber (1866), although it is identical and dates from 1850. The character of the neuration of the type, *D. variata*, . . . "

This clearly indicates that Douglas used the name purely as an emendation rather than for any other reason. Young (1952*b*) however accepted Evans' interpretation and, on the basis of his type designation, reinstated *Dicranoneura* Douglas as the correct name for *Forcipata* DeLong & Caldwell. His action is criticized by Metcalf (1953*c*) with whom the present writer is in agreement. Metcalf's inference however regarding the absence of *Dikraneura* as a synonym in Douglas' 1875*b* paper and his statement regarding the omission of *variata* as an originally included species would appear to be incorrect.

The genus *Dikraneura* was also erroneously referred to as *Dicraneura* by Puton (1886*b*), a mistake which has been perpetuated by both European and American workers. Kirkaldy (1901*a*, *f*) was the first to call attention to this error and states, in the latter paper,

> " It does not seem to be generally known that Hardy's genus was *Dikraneura* (not *Dicraneura* as usually spelt) ".

His observation, however, appears to have passed unnoticed by the majority of workers at that time since it was not until about the time of Van Duzee (1917*b*) that the correct spelling first appeared in the American literature since when it has, with few exceptions, been predominantly used. In Europe however, apart from an isolated instance (Edwards, 1908), the correct spelling does not appear to have been used until Lindberg (1924*a*), since when both spellings have been applied to an equal extent.

The genus *Chloroneura* was first described by Walsh (1862*a*) for his three new species *abnormis*, *malefica* and *maligna*. In the absence of an originally designated type-species, the genus has been variously considered, either as a synonym of *Empoasca* (Woodworth, 1889*a*; Van Duzee, 1894*a*; Melichar, 1903*b*; Distant, 1908*g*; Ball, 1924*a*; Ball & DeLong, 1925*a*), a synonym of *Dikraneura* (Van Duzee, 1916*a*, 1917*b*; DeLong, 1923*a*), a synonym in part of both *Dikraneura* and *Empoasca* (McAtee, 1918*a*) or even as a distinct genus (Ashmead, 1904*a*). It was not until McAtee (1934*a*) clearly designated the originally included species *abnormis* as its type-species that it became accepted as a synonym of *Dikraneura*.

MORPHOLOGY

The morphology of the Cicadellidae has been dealt with in detail by Ribaut (1936*b*, 1952*a*), Singh-Pruthi (1925*b*, 1929), Evans (1946*a*, 1946*b*, 1947*a*), Oman (1949*a*), Kramer (1950*a*) and Ossiannilsson *et al.* (1956). In the present study, attention has been focused on such structures of the head, thorax, wings and abdomen that provide diagnostic characters of use in delimiting both the genus and the

individual species. Segregation of the latter is facilitated in the main by characters of the male genitalia, supported in many species by the male abdominal apodemes, the shape of the head, colour and size.

The members of the genus *Dikraneura* are narrow and elongate in shape, varying in length from 2·92 mm. to 4·64 mm. The head is wider or narrower than the thorax and is angularly produced in the majority of species, the extent varying between and sometimes within species. The dorsal surface of the head, referred to as the crown or vertex, is divided along the medial line over its posterior region by a short coronal suture. The face is recurved ventrally at an angle of approximately 45° to the vertex, the margin between the two being broadly or narrowly rounded. The face, including the eyes, is usually as long as wide, but may in a few species be wider than long. Its surface is moderately convex. Its margin bordering the vertex is referred to here, unlike Evans (1947*a*), as the anterior margin whilst that from which the stylets arise as the posterior margin.

The medial area of the face, the frontoclypeus, decreases in width towards the apical anteclypeus, the suture between the two being absent or obscure. A transverse epistomal suture, separating the components of the frontoclypeus, is absent and the clypeal suture bordering it on each side extends for only a short distance beyond the antennae as the frontal suture. Postfrontal sutures, which delimit the posterior border of the frontoclypeus and connect medially with the anterior end of the coronal suture, are absent. The margin of the head between the vertex and face, however, possesses two independent parentheses-like sutures, the homologies of which are unknown. Ocelli are absent. Bordering the junction between the frontoclypeus and anteclypeus on each side is a small, crescent-shaped sclerite, the lorum. The lateral areas of the face are composed of the fused maxillary plate and gena which are here referred to jointly as the gena. The antennae are situated on the face midway between the anterior and posterior corners of the eye in the narrow region between the latter and the frontoclypeus known as the ocellocular region, the relative width of which varies within the genus. Antennal ledges, located immediately above the antennae, are absent.

The parts of the thorax visible in dorsal view are the pronotum, situated anteriorly and belonging to the prothorax and the smaller triangular shaped scutellum belonging to the mesothorax. The pronotum is usually wider than long and varies only slightly in shape between species. Its lateral margins are of moderate length, either parallel or slightly divergent posteriorly, and are broadly rounded to a shallowly concave posterior margin.

The fore wings are long and narrow, with their venation considerably reduced and devoid of cross veins basad of the apical cells as in other members of the subfamily. The four apical cells are long and narrow with the bases of the first, second and third truncate and progressively more distad. The fourth, or outer apical cell, extends more basad than the other three. No marked variation occurs between species.

In the hind wings, a submarginal vein extends from the jugal lobe, at the base of the wing, around the apex and basad along the costal border to approximately one-third the distance from the apex to the base of the latter. Vein *R* is united with the anterior branch of vein *M* near its apex and enters the submarginal vein as vein

$R + M$. Vein M_{3+4}, the posterior branch of vein M, is united with vein Cu_1 by a short cross vein, *m-cu*, in such a way that Cu_1 itself appears to be branched, the base of M_{3+4} appearing as the cross vein. Vein *m-cu* is sometimes very short or absent so that M_{3+4} appears to touch Cu_1 before proceeding to the apex. Vein Cu_2 is unbranched and enters the submarginal vein level with *m-cu*. Veins *1v* and *2v* are fused basally. As in the fore wing, no variation occurs between species.

The first two segments of the abdomen are considerably reduced as in all members of the Auchenorrhynchous Homoptera. In the genus *Dikraneura*, the sternite of the second segment in the male is produced internally as a pair of dorsoventrally flattened finger-like processes, the sternal or abdominal apodemes, which project posteriorly and are variously developed and diagnostic in different species. They serve for the attachment of muscles associated with the sound producing organs and their variation between species is a possible reflection of the differences in mating call, an ethological barrier in the reproductive isolation of the species.

In the male, the tergum and pleura of the IXth abdominal segment are modified as two lateral plates, continuous dorsally at their anterior ends, and terminating posteriorly on each side in the majority of species in a long variously directed finger-like process. They are referred to collectively as the pygofer, or pygophore, which is diagnostic for the species or species-groups within the genus. The incomplete dorsal fusion of the two halves provides a deep posterior emargination for the reception of the reduced Xth and XIth segments which are referred to respectively as the anal tube and anal style. The pygofer is fused ventrolaterally at its anterior end to the sternite of the IXth segment, or genital valve, and is closed ventrally by a pair of triangular genital or subgenital plates which articulate laterally at their base with the pygofer, the entire structure being referred to as the genital capsule. The subgenital plates offer little of diagnostic value for the separation of species. Situated ventrally within the capsule is a medial U-shaped basal plate, or connective, which articulates on each side with an elongate style, or paramere, and medially with the base of the aedeagus of which it is strictly a part. The styles, each articulating laterally with its respective subgenital plate, are of a uniform pattern for the genus and, together with the connective, offer little in the way of diagnostic species characters. The aedeagus, a composite term which comprises the fused phallobase and distal tubular aedeagus proper, consists in general of an anteroventral prolongation, the preatrium, which articulates with the connective, a basal dorsally directed apodeme for muscle attachment and a variously shaped and ornamented distal prolongation, the shaft. The latter carries the gonoduct, or endophallus, which opens at its distal end by means of the gonopore or phallotreme. The appearance of the aedeagus is diagnostic for each species and is one of the main characters used in their separation.

In the female, the last or VIIth abdominal sternum is variously shaped along its posterior margin and offers characters of diagnostic value in certain species. The pygofer, or IXth tergum, consists of a large, dorsally continuous, plate-like structure on each side of the ovipositor. The ovipositor itself is a long narrow median structure situated ventrally between the two halves of the pygofer. It consists of three pairs of valvulae, the first or anterior pair representing the VIIIth segment, and

the second or inner and the third or lateral pair representing the IXth segment. The latter pair act as an outer sheath for the other two. Apart from the VIIth sternite, the female genitalia offer little in the way of external diagnostic species characters.

TECHNIQUES

The methods used in the present study are as given by Knight (1965).

All measurements were made with the aid of a moving wire micrometer eyepiece. Body length was measured from the tip of the vertex to the apical margin of the fore wings with the latter in the position of rest alongside the body. The length of the vertex was measured along the medial line and compared with the length adjacent and parallel to the inner margin of the eye (" length next eye "). The width of the ocellocular area was measured from the inner margin of the eye to the frontal suture in a direct line above and tangential to the antennal fossa.

Colour in all cases was examined beneath a binocular microscope with the aid of a 6 volt, 30 watt tungsten filament spot-light.

ECONOMIC IMPORTANCE

The genus *Dikraneura* is found mainly on plants of the family Gramineae, although certain species have been recorded on such other economic plants as alfalfa, clover, beets, potatoes, cherry, peach and apple. Records of economic damage are limited to the species *D. carneola* (Stål), *D. absenta* DeLong & Caldwell, *D. abnormis* (Walsh) and *D. mali* (Provancher), principally in the case of grasses and grain crops such as wheat, oats, barley, rye and sweet corn. In addition, *D. carneola* and *D. absenta* have been recorded as causing economic damage to clover and alfalfa while the first of these species has been found to transmit Western X-disease virus of stone fruits. Full details of the known host range and economic importance are included under each species.

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The results of this work were embodied in a thesis submitted for the degree of Doctor of Philosophy in the Graduate School of North Carolina State University. With the approval of the Director of Research, this material has been used as the basis for the studies of the Nearctic species of *Dikraneura* in the present work, recorded as Journal Series No. 2368 of the Experiment Station, North Carolina State University.

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DIKRANEURA Hardy

Dikraneura Hardy, 1850*a* : 423.
Chloroneura Walsh, 1862*a* : 149 (Type-species: *Chloroneura abnormis* Walsh by subsequent designation of McAtee, 1934*a*).
Dicranoneura Douglas, 1875*b* : 27 [emendation].
Dicraneura Puton, 1886*b* : 86 [emendation].
Dicroneura [*sic*] Woodworth, 1888*b* : 75.
Dicranura [*sic*] Buckton, 1891*d* : 101.
Dieraneura [*sic*] Ikuma, 1903*a* : 190.
Piaraneura [*sic*] Ikuma, 1903*a* : 190.
Dikrancura [*sic*] Ribaut, 1936*b* : 198.
Dikraneura (*Notus*) DeLong & Caldwell, 1937*a* : 22.
Dikraneura (*Chloroneura*) Medler, 1943*a* : 124.

Type-species, *Dikraneura variata* Hardy, 1850, by monotypy.

Small, elongate species, yellow or yellowish green in colour, with or without two red longitudinal vittae.

Head narrower or wider than pronotum, sometimes equal; vertex moderately produced with apex obtusely or acutely angled, rarely of uniform length with anterior and posterior margins parallel, coronal suture short, surface slightly convex, broadly or narrowly rounded to face; ocelli absent; face convex, as long as or slightly longer than wide, rarely wider than long, lateral margin slightly concave beneath eyes; frontoclypeus long and narrow, decreasing gradually in width towards anteclypeus, frontal sutures extending beyond antennae to near level of anterior margin of eye, epistomal and postfrontal sutures absent; a crescent-shaped suture on anterior margin of head on each side of apex, midway between latter and eye; anteclypeus increasing in width towards its apex, the latter rounded and extending beyond margin of face, continuous with frontoclypeus or separated by only slight transverse depression; antennae situated midway between anterior and posterior corner of eye, ocellocular area equal in width to antennal fossa, rarely greater, antennal ledges absent.

Pronotum wider than long, with lateral margins moderately long, parallel or slightly divergent posteriorly, broadly rounded at posterolateral angles, posterior margin shallowly concave.

Fore wings with apical cells long and narrow, the truncate bases of cells 1–3 progressively more distad, fourth apical cell with base level with or slightly basad of that of first. Hind

wings with submarginal vein extending around apex and then basad along costal margin; vein *R* fused distally with anterior branch of vein *M*; posterior branch of vein *M* united near its base with vein Cu_1, the latter appearing branched apically; vein Cu_2 reaching submarginal vein approximately level with junction of veins *M* and Cu_1; the two vannal veins united along their basal half.

A pair of abdominal apodemes arising from second sternite in males, spatulate, variable in length, directed posteriorly.

Male pygofer with well developed posterior process usually present, with numerous setae and sometimes microspines over posterior half of lateral wall, fused anteriorly with valve; subgenital plates triangular, dorsoventrally flattened with lateral edge thickened along apical half, a uniseriate row of spine-like setae along ventrolateral edge, the basal ones usually much longer than those along apical half, lateral edge with numerous setae of variable length. Connective U-shaped. Styles elongate, broadly lobed and truncate posteriorly with lateral edge turned dorsad, a stout subapical process arising dorsally from mesal edge of lobe, its apex directed posteriorly. Aedeagus with preatrium long or short, basal apodeme well developed, shaft with paired apical or subapical processes usually present, additional paired processes usually present along its length, gonopore on posterior margin, rarely apical.

Female seventh sternum entire, wider than long, with posterior margin usually convex, sometimes concave medially and occasionally sclerotized marginally.

Dikraneura Hardy is distinguished from the closely related European genus *Erythria* Fieber (type-species, *Erythria aureola* (Fall.)) mainly by the shape of the connective, which is T-shaped or sometimes plate-like in the latter. All European species previously placed in *Dikraneura*, with the exception of *D. variata* Hardy and *D. aridella* (Sahlberg), consequently belong in Fieber's genus which will be dealt with in a later paper.

Key to Species (males only)

1		Pygofer processes recurved dorsolaterally (Text-fig. 9), rarely straight and directed dorsally (Text-fig. 216), without additional processes or teeth, pygofer processes elongate, sometimes reduced (Text-fig. 245); aedeagus with a pair of posteriorly directed apical or subapical processes always present (additional anteriorly or dorsally directed processes on shaft usually present) .	2
–		Pygofer processes recurved antero- or dorsomesally (Text-fig. 381), rarely straight and directed posteriorly (Text-fig. 457), teeth or additional processes usually present, if absent then aedeagus not as above, pygofer processes elongate (Text-fig. 307) or short and robust (Text-fig. 320), rarely absent (Text-figs. 428 and 447); aedeagus usually without a pair of posteriorly directed apical or subapical processes, if present then pygofer processes absent or with teeth (additional anteriorly or ventrally directed processes on shaft usually present)	20
2	(1)	Pygofer with prominent convexity dorsally, immediately basad of posterior process (Text-fig. 8)	3
–		Pygofer without convexity at base of posterior process (Text-fig. 214), or if present then only weakly developed (Text-figs. 180 and 247) . . .	13
3	(2)	Aedeagus with single pair of apical processes, simple, directed posteriorly at least apically (Text-figs. 40, 79 and 128)	4
–		Aedeagus with one or two pairs of apical or subapical processes, single pair when present bifurcating into an H-shaped or X-shaped structure (Text-figs. 140, 153 and 165)	11

4 (3) Aedeagus with apical processes expanded basally into a flattened shield-like plate (Text-figs. 105, 116 and 129) 5

– Aedeagus with apical processes simple, not expanded basally into a shield-like plate (Text-figs. 12, 41 and 92) 7

5 (4) Apical processes beyond basal expansion long and thin (Text-figs. 116 and 129) 6

– Apical processes beyond basal expansion short, with length subequal to width (Text-fig. 105) . . . . . ***shoshone*** DeLong & Caldwell (p. 134)

6 (5) Aedeagus with shaft straight, directed dorsally (Text-fig. 115); pygofer with expansion at base of posterior process decreasing gradually in height posteriorly, its basal width approximately twice its height, with microspines and hair-like setae posterolaterally (Text-fig. 114) . . . . ***ossia*** Beirne (p. 136)

– Aedeagus with shaft arched posteriorly (Text-fig. 130); pygofer with expansion at base of posterior process decreasing abruptly in height posteriorly, its basal width subequal to its height, with elongate spine-like setae posterolaterally (Text-fig. 127) . . . . . ***hungerfordi*** Lawson (p. 138)

7 (4) Abdominal apodemes each with length approximately twice width (Text-fig. 97); aedeagus with processes arising laterally on shaft near midlength (Text-fig. 91) . . . . . ***omani*** sp. n. (p. 132)

– Abdominal apodemes each with length subequal to width (Text-figs. 10 and 81); aedeagus with processes arising posterolaterally near apex (Text-fig. 40), or absent 8

8 (7) Aedeagus with posterolateral processes present 9

– Aedeagus with posterolateral processes absent ***absenta*** DeLong & Caldwell (p. 126)

9 (8) Aedeagus with posterolateral processes extending anteriorly beyond anterior margin of shaft to near level of posterior margin of basal apodeme (Text-fig. 79) . . . . . ***aridella*** (Sahlberg) (p. 130)

– Aedeagus with posterolateral processes extending anteriorly but not exceeding level of anterior margin of shaft (Text-figs. 11 and 40) 10

10 (9) Aedeagus in lateral aspect with width of shaft immediately distad and basad of gonopore subequal (Text-figs. 11 and 17–29); pygofer with microspines over posterior region of lateral wall; abdominal apodemes directed posteriorly, spatulate (Text-fig. 10) . . . . . ***variata*** Hardy (p. 114)

— Aedeagus in lateral aspect with width of shaft immediately distad of gonopore approximately one-half width immediately basad of gonopore (Text-figs. 40 and 46–58); pygofer without microspines over posterior region of lateral wall; abdominal apodemes directed dorsally, spoon-shaped (Text-fig 39) . . . . . ***carneola*** (Stål) (p. 120)

11 (3) Aedeagus with one pair of laterally directed bifurcate apical processes, a pair of processes arising laterally on shaft just basad of apex (Text-figs. 152 and 153) 12

— Aedeagus with 2 pairs of subapical processes, one directed anteriorly and the other posteriorly, without lateral processes on shaft (Text-fig. 165) ***urbana*** Ball & Delong (p. 145)

12 (11) Aedeagus elongate with length of shaft distad of gonopore approximately three times width at gonopore, apical processes appearing H-shaped in dorsal aspect (Text-figs. 152 and 153) . . . ***etiolata*** **sp. n.** (p. 143)

— Aedeagus robust with length of shaft distad of gonopore subequal to its width at gonopore, apical processes appearing X-shaped in dorsal aspect (Text-figs. 139 and 140). . . . . ***abnormis*** (Walsh) (p. 140)

13 (2) Pygofer with posterior processes elongate, their length 4–5 times their basal width, clearly demarcated (Text-fig. 180). 14

— Pygofer with posterior processes very short, their length approximately two times their basal width, merging with pygofer and not clearly demarcated (Text-fig. 263) 18

14 (13) Abdominal apodemes each with length subequal to width (Text-fig. 191); aedeagus with apical processes expanded basally into large plate-like structure (Text-fig. 181) . . . ***rubrala*** DeLong & Caldwell (p. 148)

— Abdominal apodemes each at least twice as long as wide (Text-fig. 203); aedeagus with apical processes not expanded basally (Text-figs. 202 and 240) 15

15 (14) Pygofer with detached, elongate sclerite situated in membrane dorsomesad of base of posterior process (Text-fig. 198) ***arizona*** DeLong & Caldwell (p. 150)

— Pygofer without detached sclerite at base of posterior process. 16

16 (15) Pygofer processes straight, directed dorsally (Text-fig. 216); aedeagus with subapical processes and with posterolateral processes triangular (Text-fig. 217) . . . . . ***triangulata*** sp. n. (p. 153)

— Pygofer processes curved, their apices directed dorsolaterally (Text-fig. 231); aedeagus with apical processes and with lateral or posterolateral processes elongate (Text-fig. 228) 17

17 (16) Aedeagus with apical processes laterally compressed, a pair of shorter processes arising posterolaterally immediately basad of gonopore (Text-figs. 228 and 229) . . . . . ***latacephala*** Beamer (p.155)

— Aedeagus with apical processes needle-like, a pair of shorter processes arising laterally near base of shaft (Text-figs. 239 and 240). ***ungulata*** Beamer (p. 157)

18 (13) Aedeagus with posterior margin terminating in an acute, medial, spine-like process; lateral or posterolateral processes arising basad of gonopore (Text-figs. 248 and 265) 19

— Aedeagus without spine-like process at apex of posterior margin; posterolateral processes arising alongside distal half of gonopore (Text-fig. 282) . ***rubica*** Delong & Caldwell (p. 164)

19 (18) Aedeagus with anterior processes near midlength of shaft very short and broadly triangular, much wider basally than long, a pair of elongate processes arising posterolaterally on shaft immediately basad of gonopore (Text-fig. 248); abdominal apodemes each with length approximately 1½ times width (Text-fig. 256) . . . . . ***retusa*** Beamer (p. 159)

— Aedeagus with anterior processes near midlength of shaft long and spine-like, 2–3 times longer than wide, a pair of elongate processes arising laterally on shaft near midlength but not immediately basad of gonopore (Text-fig. 265); abdominal apodemes each with length 3 times width (Text-fig. 276) . . . . . ***rufula*** Gillette (p. 160)

20 (1) Pygofer with posterior processes elongate or short and robust, recurved dorsomesally or anteromesally, with or without teeth or additional processes (Text-figs. 302 and 320); vertex and pronotum with two longitudinal red vittae, rarely indistinct 21

— Pygofer with posterior processes absent or short and directed posteriorly, never recurved, without teeth or additional processes (Text-figs. 431 and 457); vertex and pronotum without two longitudinal red vittae. . . 31

21 (20) Aedeagus with two pairs of processes arising from posterior margin near midlength (Text-fig. 371); pygofer process with an elongate process arising dorsally anterior to recurved portion, teeth absent (Text-fig. 370) ***stonei*** Ruppel & DeLong (p. 176)

— Aedeagus with only one pair of processes near midlength or absent (Text-fig. 294); pygofer processes without an elongate process anterior to recurved portion, teeth present or absent 22

22 (21) Pygofer with posterior processes elongate, without teeth, or limited to a single one near base (Text-figs. 293 and 297); aedeagus with a laterally compressed nose-like projection on posterior margin near midlength immediately basad of posterolateral processes, without paired apical processes (Text-figs. 294–296) . . . . . ***vittata*** Borland (p. 166)

— Pygofer with posterior processes elongate or short and robust, with teeth, if elongate then teeth numerous (Text-figs. 307 and 320); aedeagus without projection near midlength of posterior margin, with or without paired apical processes 23

23 (22) Aedeagus directed dorsally or posterodorsally with a pair of elongate processes arising from posterior margin of shaft near midlength immediately basad, distad or laterad of gonopore, visible in posterior aspect (Text-figs. 322 and 359) 24

— Aedeagus directed posterodorsally with a pair of elongate processes arising from lateral margin of shaft near midlength, not or rarely visible in posterior aspect, if visible then situated distad of gonopore by distance at least equal to their length (Text-figs. 384 and 409); or aedeagus S-shaped with apex turned ventrally and with lateral processes short, widely based and flap-like (Text-fig. 419) 28

24 (23) Aedeagus with a large rugose lobe on each side at base of shaft (Text-fig. 311) ***serrata*** DeLong & Caldwell (p. 168)

— Aedeagus without a large rugose lobe on each side at base of shaft . . . 25

25 (24) Aedeagus with a pair of short apical or subapical processes directed anteriorly or posteriorly (Text-figs. 336 and 359) 26

— Aedeagus without a pair of short apical or subapical processes (Text-fig. 322) ***beameri*** Borland (p. 170)

26 (25) Aedeagus with apical processes narrow and directed anterodorsally, midshaft processes directed anteriorly (Text-fig. 336) 27

— Aedeagus with subapical processes triangular and directed posteriorly, midshaft processes directed ventrally (Text-fig. 359) ***halberda*** Ruppel & DeLong (p. 175)

27 (26) Aedeagus with distal half of shaft approximately twice as wide in lateral aspect as basal half, posterior processes arising immediately laterad of gonopore (Text-fig. 336); abdominal apodemes narrow, each 3 times as long as wide, separated by distance greater than their individual width (Text fig. 344) ***jalapensis,*** sp. n. (p. 171)

— Aedeagus with distal and basal half of shaft of subequal width, posterior processes arising immediately basad of gonopore (Text-fig. 348); abdominal apodemes wide, each approximately twice as long as wide, separated by distance equal to one third their individual width (Text-fig. 353) ***dreisbachi*** sp. n. (p. 173)

28 (23) Aedeagus with shaft S-shaped in lateral aspect (Text-fig. 419) . . . ***ardea*** Ruppel & DeLong (p. 185)

— Aedeagus with shaft elongate, straight or slightly curved but never S-shaped (Text-fig. 384) 29

29 (28) Aedeagus with lateral processes visible in posterior aspect (Text-fig. 410) ***arcta*** DeLong & Caldwell (p. 183)

— Aedeagus with lateral processes not visible in posterior aspect (Text-fig. 385) . 30

30 (29) Pygofer process with teeth on posteroventral surface of elbow (Text-fig. 396); abdominal apodemes wide, separated by distance approximately one-third their individual width, parallel, each approximately 2½ times as long as wide (Text-fig. 406) . . . . . ***torta*** DeLong & Caldwell (p. 181)

— Pygofer process without teeth on posteroventral surface of elbow (Text-fig. 382); abdominal apodemes narrow, separated basally by distance equal to their individual width, divergent, each approximately 4 times as long as wide (Text-fig. 391) . . . . . ***angustata*** Ball & DeLong (p. 178)

31 (20) Pygofer with posterior process short, directed posteriorly; subgenital plates each with a sclerotized tooth situated subapically on dorsal surface (Text-fig. 457) . . . . . ***denticulata*** sp. n. (p. 193)

— Pygofer without posterior process; subgenital plates without sclerotized tooth (Text-figs. 431 and 442) 32

32 (31) Aedeagus with only one pair of apical processes (Text-fig. 445) ***mali*** (Provancher) (p. 189)

— Aedeagus with two pairs of apical processes (Text-fig. 432) ***robusta*** Lawson (p. 186)

DESCRIPTIONS OF SPECIES

Dikraneura variata Hardy

(Text-figs. 1–29)

Dikraneura variata Hardy, 1850*a* : 423.
Notus luteolus Fieber, 1872*a* : 14 [nom. nud.]
Notus agnatus Fieber, op. cit. : 14 [nom. nud.]
Notus agnatus Lethierry, 1874*a* : 273.
Dikraneura lenensis Linnavuori, 1953*a* : 116. **syn. n.**

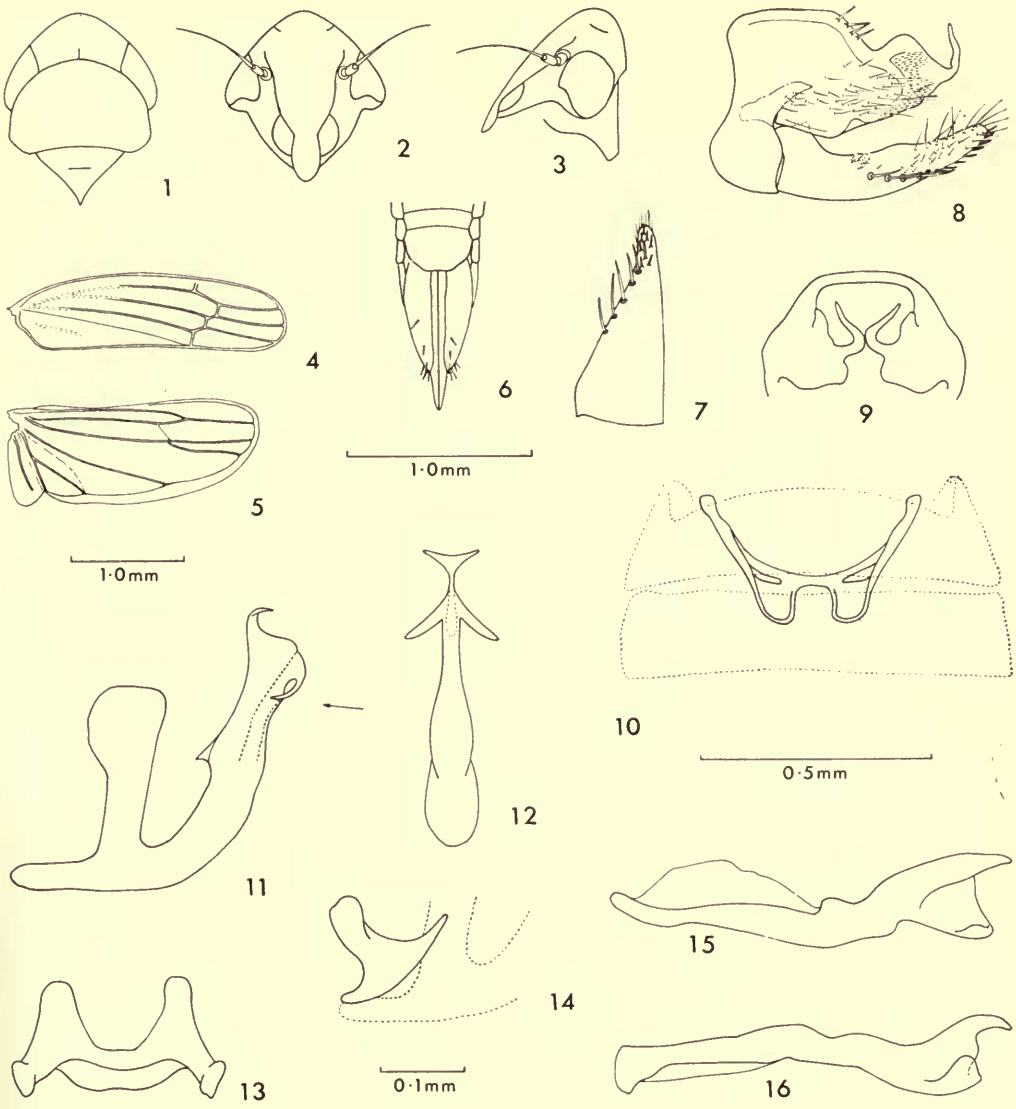
Length: ♂ 2·92–3·64 mm. (mean 3·20 mm.). ♀ 3·22–4·08 mm. (mean 3·58 mm.).

Head with width greater than that of pronotum, moderately produced with apex broadly rounded in dorsal aspect, medial length approximately 1½ times length next eyes, broadly rounded to face with latter approximately as long as wide, ocellocular area 1¼ times width of antennal fossa; pronotum with width increasing only slightly posteriorly.

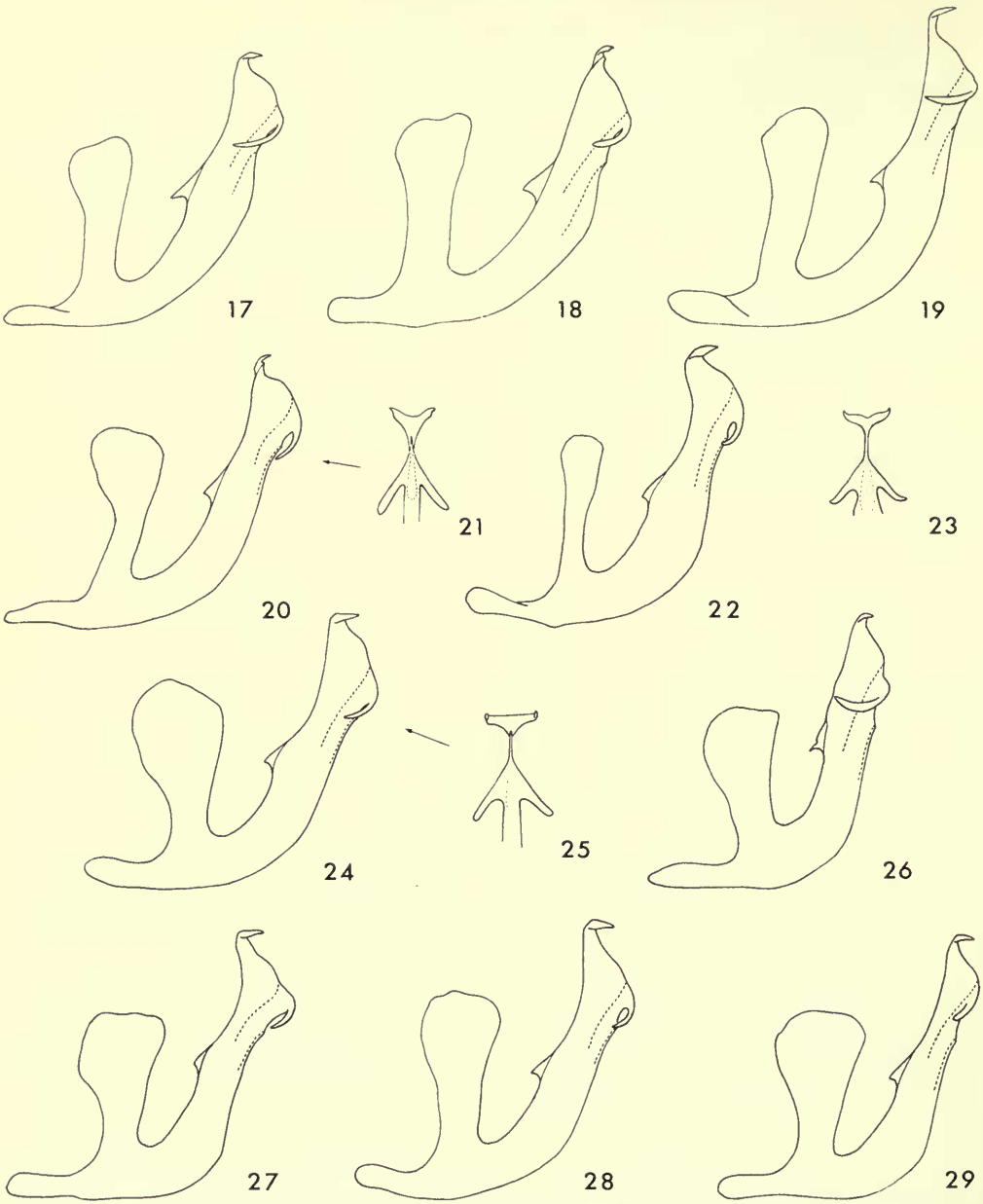
Colour of head sordid light brownish, paling to cream laterally on genae, with anteclypeus, medial area of frontoclypeus, and vertex sometimes washed with greenish yellow, a small patch above antenna whitish, sometimes indistinct, with marginal sutures yellowish or orange; vertex with narrow medial longitudinal stripe to near apex cream, absent or poorly developed in European specimens; eyes testaceous. Pronotum greenish yellow with discal area pale brownish or pale reddish brown, rarely deep red, lateral borders cream marked with yellow, medial line pale, sometimes indistinct; scutellum cream marked with yellow; remainder of thorax dark brown marked laterally with yellow. Legs pale stramineous. Fore wings with basal area subhyaline greenish yellow, sometimes pale, often sordid, rarely deep red; apical half hyaline smoky brown with veins yellowish. Hind wings hyaline with veins dark brown. Abdomen with dorsum and venter dark brown to black with lateral edges of former sometimes yellow, sternites with lateral and posterior margins often yellow or whitish yellow; male pygofer and anal tube dark brown, subgenital plates pale fawn, occasionally whitish or pale yellowish, valve dark brown or concolorous with plates; female pygofer cream with dorsal surface and apex of ovipositor beyond pygofer dark brown, sternum VII cream.

Male abdominal apodemes short, with length of each subequal to width, extending to near middle of fourth segment, sometimes absent.

Male genitalia with pygofer tapering posteriorly in lateral aspect and terminating in a narrow, finger-like process directed medially and then abruptly dorsolaterally, with a dorsal convexity immediately basad of process; dorsolateral margin with variable number of short spine-like setae near midlength; lateral wall with numerous randomly scattered setae over medial area, their length increasing posteriorly, with microspines over posterior area. Aedeagus with preatrium and dorsally directed basal apodeme well developed, the latter expanded apically; shaft directed dorsally, laterally compressed over apical half and tapering to a pair of laterally directed apical processes, their apices turned posteriorly; a pair of subapical processes on



FIGS. 1–16. *Dikraneura variata* Hardy. 1, head, pronotum and scutellum, dorsal view; 2, face; 3, head and pronotum, left lateral view; 4, fore wing; 5, hind wing; 6, female genitalia, ventral view; 7, left subgenital plate, ventral view; 8, male pygofer, valve and subgenital plates, left lateral view; 9, male pygofer, posterior view; 10, abdominal apodemes, dorsal view; 11, aedeagus (British Isles), left lateral view; 12, aedeagus, posterior view in direction of arrow in previous fig.; 13, connective, anterodorsal view; 14, connective, left lateral view; 15, left style, dorsal view; 16, left style, left lateral view. Scale as shown with head and female genitalia to same scale, male pygofer and abdominal apodemes to same scale and aedeagus, styles and connective to same scale.



FIGS. 17–29. *Dikraneura variata* Hardy. 17, aedeagus (Denmark), left lateral view; 18, same (Denmark); 19, same (Finland); 20, same (Mono Lake, California); 21, apex of aedeagus, posterior view in direction of arrow in previous fig.; 22, aedeagus (Saskatoon, Saskatchewan), left lateral view; 23, apex of aedeagus (Stirling, Alberta), posterior view; 24, aedeagus (Indian Head, Saskatchewan), left lateral view; 25, apex of aedeagus, posterior view in direction of arrow in previous fig.; 26, aedeagus (Lapine, Oregon), left lateral view; 27, same (Lapine, Oregon); 28, same (Saskatoon, Saskatchewan); 29, same (Lapine, Oregon). Scale as in figs. 11–16.

posterior surface, directed ventrolaterally and then anteriorly; a pair of short, acute, triangular processes on anterior surface of shaft near midlength; gonopore subapical on posterior margin between bases of posterior processes.

Female genitalia with posterior margin of sternum VII broadly rounded with medial sector transverse or slightly concave.

Distribution. BRITISH ISLES (Hardy, 1850*a*; Bold, 1867*a*; Norman, 1879*a*, 1880*a*; Cooke, 1882*a*; Edwards, 1884*c*, 1885*a*, 1896*b*; M'Gregor, 1893*a*, *b*; Morley, 1905*b*; Oshanin, 1906*a*; Butler, 1909*a*; Britten, 1919*a*; Brown, 1925*a*, 1937*a*; Thornley, 1934*a*; Roche, 1944*a*). FRANCE (Lethierry, 1874*a*; Reiber & Puton, 1880*a*; Dubois, 1888*a*; Dominique, 1890*a*, 1892*a*; Carpentier & Dubois, 1892*a*; Lambertie, 1901*a*, 1910*a*; Oshanin, 1906*a*; Ribaut, 1936*b*). BELGIUM (Lethierry, 1878*c*, 1892*b*; Fagel, 1949*a*). NETHERLANDS (Fokker, 1891*a*; Blöte, 1927*b*, *d*). DENMARK (Trolle, 1966). GERMANY (Melichar, 1896*a*; Oshanin, 1906*a*; Haupt, 1912*b*; Peus, 1928*a*; Wagner, 1935*a*, 1939*a*, 1941*a*; Kuntze, 1937*a*, *b*; Rabeler, 1951*a*). SWITZERLAND (Cerutti, 1939*a*). ITALY (Ferrari, 1882*a*, 1892*a*; Bezzi, 1893*a*; Cobelli, 1902*a*, 1909*a*). AUSTRIA (Then, 1886*a*; Melichar, 1896*a*; Oshanin, 1906*a*; Stichel, 1922*a*; Franz, 1943*a*). HUNGARY (Horvath, 1897*c*; Oshanin, 1906*a*; Dlabola, 1954*d*). CZECHOSLOVAKIA (Duda, 1892*a*; Spitzner, 1892*a*; Lang, 1945*c*; Dlabola, 1954*a*). ROUMANIA (Montandon, 1900*a*; Oshanin, 1906*a*). GREECE (Paganetti-Hummler, 1907*a*). TURKEY (Fahringer, 1922*a*). POLAND (Matsumura, 1906*a*; Nast, 1938*d*; Wagner, 1941*a*; Smreczynski, 1954*a*). W. RUSSIA (Oshanin, 1906*a*; Ivanov, 1928*b*). FINLAND (Oshanin, 1906*a*; Lindberg, 1924*a*, 1943*b*). UNITED STATES (Oman, 1949*a*).

Specimens seen. BRITISH ISLES: Scotland, Inverness, Aviemore, 11 ♂, viii.1939 (*P. Harwood*); England, Surrey, Holmbury, 1 ♂, viii.92 (*E. A. Butler*); England, Surrey, Shirley, 1 ♂, 29.ix.1900 (*W. West*); England, Somerset, Porlock, 2 ♂, 9.ix.56 (*W. J. LeQuesne*); England, Cornwall, Tintagel, 1 ♂, viii.08 (*E. A. Butler*); no locality, 2 ♂, no date (*Douglas Collection*). DENMARK: Kongshus, 11 ♂, 4 ♀, 21.ix.1915, 1 ♂, 2.viii.1915, 1 ♂, 1 ♀, 8.ix.19 (*Jensen-Haarup*); Silkeborg, 1 ♂, 6.x.1868 (*O. G. Jensen*); Silkeborg, 1 ♀, 6.viii.22 (*Jensen-Haarup*); no locality, 1 ♂, 15.ix.87 (*O. Jacobsen*); no locality, 1 ♂, no date (*Jensen-Haarup*); Hansted res. Jyll. Kystklitter, 1 ♂, 3 ♀, 3.viii.1963 (*N. P. K.*); Hansted res. Jyll. ø sbl. dal., 1 ♂, 25.viii.1962 (*N. P. K.*); Tebbestrup Bakker, 2 ♀, 16.ix.1910 (*O. Jacobsen*); no locality, 1 ♀, no date (*O. Jacobsen*); Thorsö I., 1 ♀, 4.viii.19, 1 ♀, 18.viii.20 (*Jensen-Haarup*); Vejle, 2 ♀, 9.x.1868 (*O. G. Jensen*); Langå, 1 ♀, 31.v.1891 (*O. Jacobsen*); Sønderborg on Als, 1 ♀, 12.ix.91 (*Wüstnei*). FINLAND: Suomi EH Lammi, 1 ♂, 7.viii.1948 (*R. Linnavuori*); Suomi A M Lamn, 1 ♀, 6.vi.1948 (*R. Linnavuori*); Suomi Perniö, 1 ♀, 22.vi.1948 (*R. Linnavuori*). GERMANY: Hamburg, Börnsen, 1 ♀, 15.vii.32 (*Pillich*); Umg. v Hamburg, Ramelsloh, 2 ♂, 2 ♀, 19.vii.48 (*W. Wagner*). HUNGARY: Isaszeg Sztudva, 1 ♂, 10.vii.1904 (*no collector*). CZECHOSLOVAKIA: Rohatec, Moravia merid., 1 ♀, 9.vii.42 (*Hoffer*). CANADA: Yukon, Dawson, 1 ♀, 10.vi.1949 (*W. W. Judd*); B. C., Soda Creek, 1 ♂, 19.vii.1951, 1 ♂, 21.viii.1951 (*H. R. MacCarthy*), 2 ♂, 2 ♀, 22.vii.1949 (*R. Stace-Smith*); B. C., Tranquilla, 1 ♀, 21.iv.1948 (*C. L. Neilson*); B. C., Vernon, 1 ♀, 16.ix.1931 (*R. D. Bird*); B. C., Creston, 1 ♀, 9.ix.1948 (*D. B. Waddell*); B. C.,

Summerland, 1 ♀, 26.ix.1932, 1 ♀, 1.v.32 (*A. N. Gartrell*); B. C., Oliver, 2500', 1 ♀, 2.vii.1953 (*J. R. McGillis*); B. C., Jesmond, 1 ♀, 30.viii.38 (*J. K. Jacob*); B. C., Riske Creek, 1 ♀, 29.vii.1949 (*G. J. Spencer*); B. C., Penticton, 2 ♀, 5.x.1931, 1 ♀, 9.ix.1931 (*R. D. Bird*); B. C., Chimney Cr., 1 ♂, 29.vii.1949 (*G. J. Spencer*); B. C., Willow Pt., 1 ♀, 2.vii.1948 (*D. B. Waddell*); Alta., Stirling, 1 ♂, ix.1926 (*H. L. Seamans*); Alta., Lethbridge, 1 ♂, 22.x.1937 (*G. F. Manson*); Sask., Indian Head, 1 ♂, 20.ix.1929, 1 ♀, 9.vii.1929 (*K. Stewart*); Sask., Saskatoon, 2 ♀, 15.ix. 1924, 1 ♂, 22.iii.1926, 1 ♂, 8.viii.1927, 1 ♂, 17.x.1927, 1 ♂, 7.ix.1927, 1 ♂, 25.v.1928, 1 ♂, 9.vii.1928, 1 ♂, 21.viii.1928, 1 ♂, 9.vii.1929, 1 ♂, 8.viii.192– (*K. M. King*), 13 ♂, 19 ♀, 13.vi.1949, 2 ♂, 2 ♀, 8.vi.1949, 3 ♀, 7.v.1951, 1 ♂, 1 ♀, 15.vii.1949, 2 ♀, 21.vii.1949, 6 ♂, 2 ♀, 17.viii.1949, 1 ♀, 20.vi.1949, 1 ♂, 10.vi.1949, 1 ♂, 2 ♀, 16.viii.1949, 1 ♂, 1 ♀, 25.v.1949 (*L. Konotopetz*), 17 ♀, 10.v.1951, 1 ♂, 8 ♀, 16.viii.1949, 4 ♀, 13.vi.1949, 4 ♂, 3 ♀, 17.viii.1949, 1 ♀, 21.vii.1949 (*A. R. Brooks*); Sask., Plato, 1 ♂, 28.iv.1925, 2 ♀, 28.vii.1925 (*N. J. Atkinson*); Sask., Elbow, 3 ♀, 7.viii.1951 (*A. R. Brooks*); Man., Carberry, 1 ♀, 20.v.1953 (*Brooks & Kelton*); Man., Brandon, 1 ♂, 26.v.50 (*T. V. Cole*). UNITED STATES: Ore., Lapine, 3 ♂, 2 ♀, 2.vii.1935 (*Oman*); Cal., Mono Lake, 2 ♂, 31.vii.40 (*D. E. Hardy*).

New Records: Canada, United States.

The whereabouts of Hardy's type series of *D. variata* from the British Isles (Lobley Hill, Northumberland, and the coast of Berwickshire, Scotland) are unknown and the specimens are presumed lost or destroyed. Walker (1851*b*) lists one specimen in the British Museum Collection from Scotland, presented by J. Hardy, which might have been intended as the type but which unfortunately is no longer present. In the absence of suitable topotypic material, a neotype is not designated.

The holotype ♂ of *D. lenensis* Linnavuori, the only available specimen of this nominal species and located in the Universitetets Zoologiska Museum, Helsinki, was studied.

The holotype of *Notus agnatus* Lethierry was not studied.

Biology. *Dikraneura variata* is a fairly common species found throughout the year. It apparently overwinters in the adult stage (Buckton, 1891*d*; Wagner, 1935*a*, 1941*a*). The earliest emergence records are for February in Germany (Wagner, 1935*a*), March in England (Roche, 1944*a*) and April in the Netherlands (Blöte, 1927*b*). Its latest recorded occurrence is October in Scotland (Hardy, 1850*a*; Marshall, 1867*b*), France (Lambertie, 1901*a*) and Germany (Wagner, 1935*a*) and November at Kiev (Ivanov, 1928*b*). Wagner (1935*a*) also records the presence of nymphs in Germany during July.

The periods of peak emergence are reported as April and July in Germany (Wagner, 1939*a*), March and July in England (Roche, 1944*a*) and April to May and July to September in the Netherlands (Blöte, 1927*b*). In France however it is recorded as common during the end of the summer and autumn (Dominique, 1890*a*; Carpentier & Dubois, 1892*a*; Lambertie, 1901*a*) as is also the case for Scotland (Hardy, 1850*a*; M'Gregor, 1893*a*). Melichar (1896*a*) records it also during July to September in Austria. Lethierry (1874*a*) however found it to be fairly common in France during

May and June. In Germany, Wagner (1935*a*) reports it as occurring from February to October and Kuntze (1937*a*, *b*) also says it is present the whole year.

In N. America, it is again found throughout the year. Specimens at hand indicate its presence during May in British Columbia, Manitoba and Saskatchewan and even as early as April in the former province. It has been found also as late as September in Alberta and Saskatchewan and as late as October in British Columbia.

It is found mainly in grass (Hardy, 1850*a*; Marshall, 1867*b*; Lethierry, 1874*a*; Dominique, 1890*a*; Matsumura, 1906*a*; Blöte, 1927*b*; Wagner, 1935*a*, 1939*a*, 1941*a*; Kuntze, 1937*b*; China, 1943*a*) and low plants (Edwards, 1888*d*; Butler, 1909*a*; Britten, 1919*a*; China, 1943*a*), is a common inhabitant of meadows (Then, 1886*a*; Spitzner, 1892*a*; Melichar, 1896*a*; Fahringer, 1922*a*; Haupt, 1935*a*; Ribaut, 1936*b*; China, 1943*a*) and is often found in grasses in woods (Hardy, 1850*a*; Marshall, 1867*b*; Lethierry, 1874*a*; Ribaut, 1936*b*; China, 1943*a*) and coniferous forests (Wagner, 1939*a*, 1941*a*) especially beneath Scotch Pine (Wagner, 1935*a*; Kuntze, 1937*b*; Rabeler, 1951*a*). Linnavuori (1952*a*) records it in dry *Vaccinium*-pine woods. It has also been taken on grassy heaths (Haupt, 1935*a*; Kuntze, 1937*b*), sandy soil (Haupt, 1935*a*), grassy sand hills (Marshall, 1867*b*) and at the roots of marram grass on sand dunes (Brown, 1937*a*). Fagel (1949*a*) records it in general from the base of plants of dry and sunny ground. In contrast, Dubois (1888*a*) and Carpentier & Dubois (1892*a*) have found it in swamps and marshes whilst Edwards (1885*a*, 1888*d*) and Lambertie (1901*a*) record it also from damp humid places. Specific host plants include *Festuca ovina* L. and *Aira flexuosa* L. in woods (Hardy, 1850*a*), *Onopordon tauricum* Willd. in meadows (Fahringer, 1922*a*), *Geranium robertianum* L. in sea caverns (Hardy, 1850*a*) and *Juncus effusus* L. (Matsumura, 1906*a*).

Remarks. *Dikraneura variata* has been recorded extensively throughout Europe. In 1949, Oman listed it from Pennsylvania in his Check List of Nearctic Leafhoppers but unfortunately gave no corroborative evidence. Beirne (1952*b*, 1956) in a treatment of the leafhoppers of Canada figured it for N. America but failed to recognize its relationship to Hardy's species and recorded it as a variant of the closely related species *D. carneola* (Stål). Linnavuori (1953*a*) described a form from Siberia which, although acknowledged to be closely related to *D. variata*, was considered to be a new species, *D. lenensis*. Vilbaste (1965) has also described a form from the Altay region of Russia similar to that of *D. lenensis* but which he tentatively considered, together with *D. lenensis*, as *D. carneola*. In the present study, an examination of material from the British Isles, Europe and N. America, together with the holotype of *D. lenensis*, shows that Hardy's species is more widespread than previously thought and extends from Europe eastwards into the northwest coastal area of N. America.

A noticeable feature of *D. variata* is the variability in the apical region of the aedeagus throughout its geographical range. The form typical of the British Isles, as well as a number of specimens from the European continent, is shown in Text-fig. 11. In general, the continental forms show a more gradual tapering at the apex of the shaft (seen also in some specimens from the British Isles), the apical processes more slender and a slight increase in the length of the subapical processes (Text-figs.

17, 18 and 19). This variability is very marked in the Nearctic region (Text-figs. 20–29) even within the same population (Text-figs. 26, 27 and 29) yet certain forms show a strong resemblance to those from Europe (cf. Text-fig. 17 with 20 and 19 with 28). The form described from Siberia as *D. lenensis* Linnavuori as well as that described by Vilbaste (1965) is seen to fit within this variability range and suggests the presence of *D. variata* throughout the Palaearctic region, a fact which only further collecting in this area can verify.

In addition to the above variation, there is a noticeable increase in body length between Europe and N. America. This varies in the males from 2·92–3·24 mm. (mean 3·04 mm.) in the British Isles, 3·12–3·36 mm. (mean 3·24 mm.) in Europe and 3·34–3·64 mm. (mean 3·44 mm.) in N. America. The females, which are slightly larger in general than the males, show a similar increase. The body is also more slender in the Nearctic forms and the head more variable in the acuteness of its apex, ranging from that seen in the European forms (Text-fig. 1) to that of *D. carneola* (Stål) (Text-figs. 30 and 31). The Nearctic forms are also much paler in general than the European forms with the disc of the pronotum and basal half of the fore wings often pale pink.

D. variata is very closely related to the N. American species *D. carneola* (Stål) particularly in the shape of the aedeagus. That of *D. carneola* however is relatively smaller and much narrower and more elongate apically in lateral aspect with the apical processes directed more dorsad. Like *D. variata*, *D. carneola* shows a certain, though less well marked, variability in the shape of the aedeagus (Text-figs. 46–58). A comparison of these figures with those of *D. variata* however shows the range to be distinct in both species without visible evidence of overlap. In addition, *D. variata* is distinguished by its slightly larger and more elongate pygofer, the presence of microspines over the posterior region of the lateral wall of the latter and by its larger and more posteriorly directed abdominal apodemes. Externally, the European forms of *D. variata* are readily distinguishable from *D. carneola* by their shorter and more robust shape and their more sordid coloration. The Nearctic forms of *D. variata* however are more difficult to distinguish externally from *D. carneola*, although in general *D. variata* is much paler in colour with the ventral surface of the female pygofer cream rather than dark brown. The vertex is also more obtusely angled anteriorly in *D. variata*. They occur sympatrically over the north-west region of N. America and have been taken together at Lapine, Oregon, and Mono Lake, California, thereby indicating their status as distinct species rather than subspecies. Further collecting is undoubtedly required in this area, as well as throughout Siberia, in order to determine more conclusively the relationship of these two species.

Dikraneura carneola (Stål)

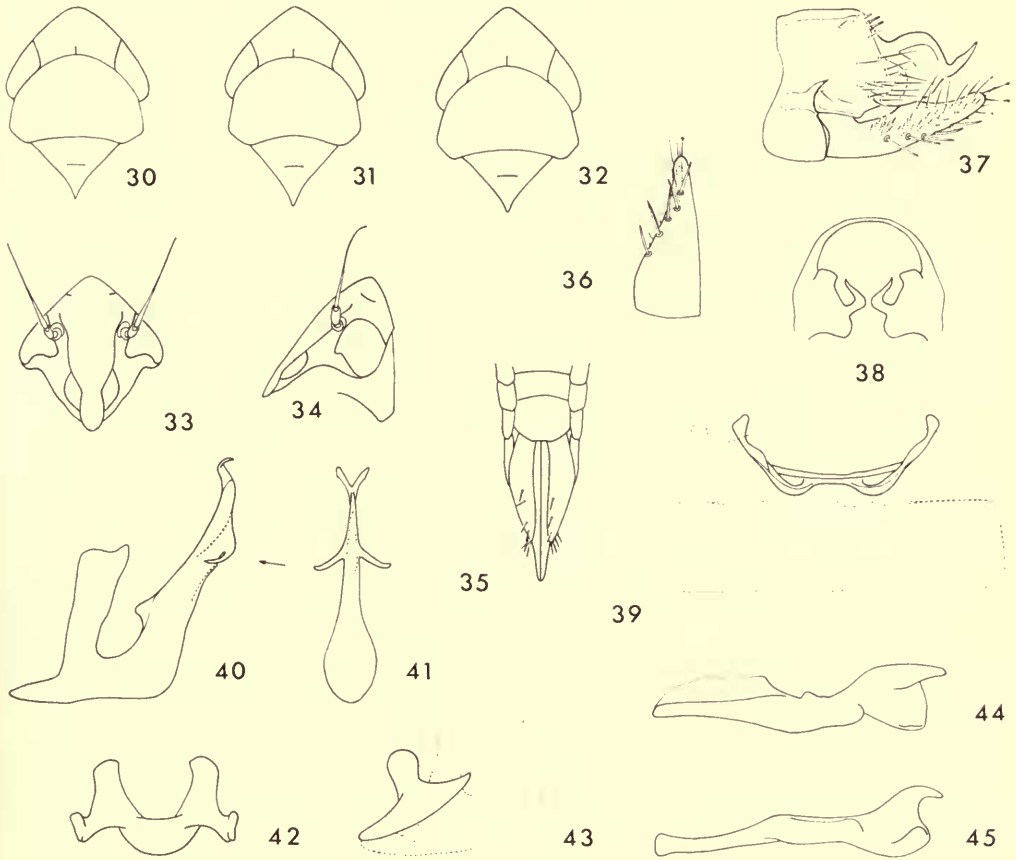
(Text-figs. 30–58)

Typhlocyba carneola Stål, 1858*e* : 196.
Dikraneura carneola var. *sitkana* Ball & DeLong, 1925*a* : 330.

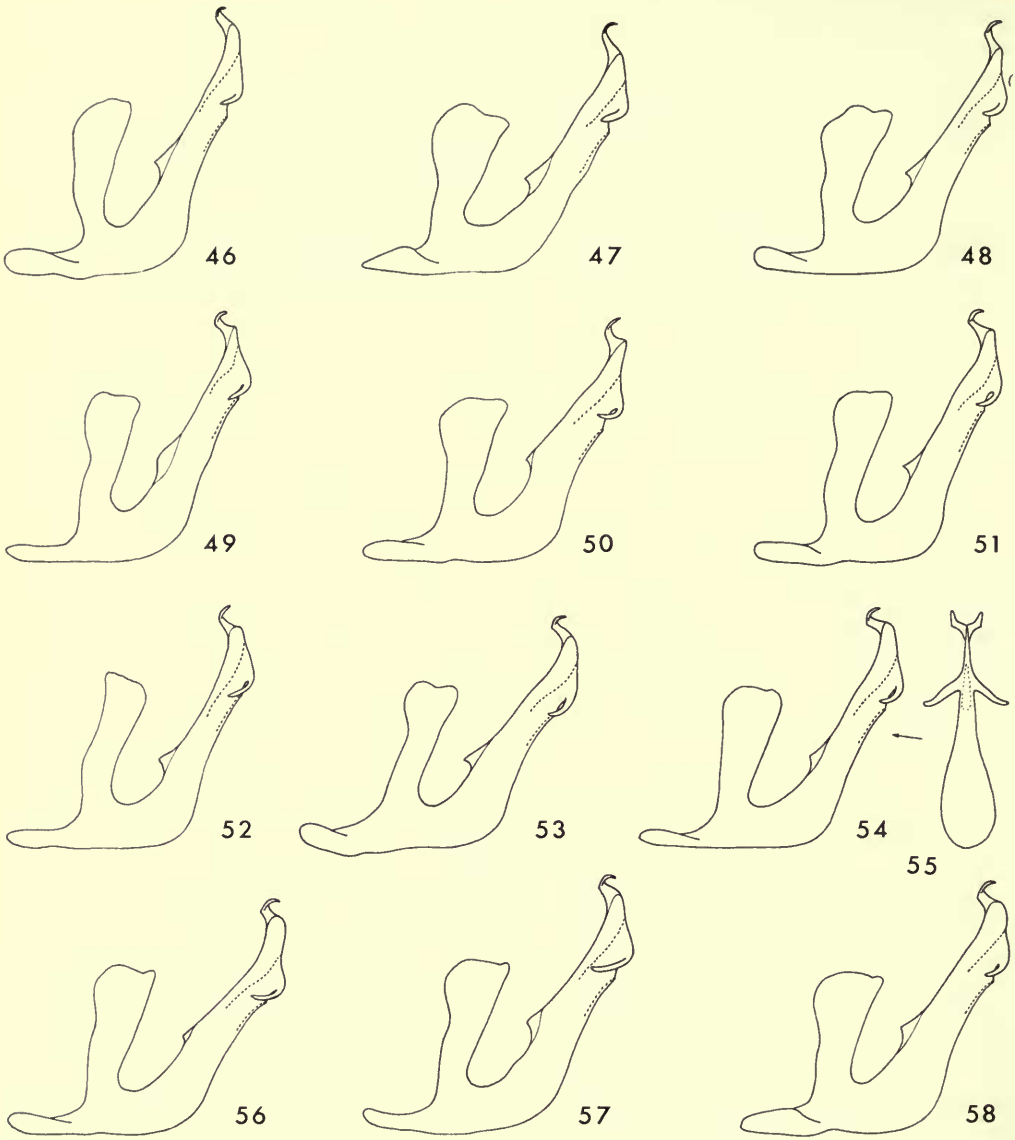
Length: ♂ 3·32–3·90 mm. (mean 3·63 mm.). ♀ 3·62–4·24 mm. (mean 3·88 mm.).

Head with width equal to or slightly greater than pronotum, vertex angularly produced with apex narrowly or broadly rounded in dorsal aspect, with medial length $1\frac{1}{2}$–$1\frac{3}{4}$ times length next eyes, narrowly rounded to face with latter approximately as long as wide, with ocellocular area equal in width to antennal fossa; pronotum with width increasing only slightly posteriorly.

Colour of face sordid cream or pale brownish with anteclypeus yellowish and genae cream; vertex usually paler than face, often cream, usually washed with yellow, rarely orange, sometimes with a small patch on either side of midline just behind apex orange or yellow, with narrow medial longitudinal stripe cream, sometimes obscure; sutures on anterior margin usually orange with marginal area between cream, a small oval patch immediately above base of antenna whitish, sometimes obscure; eyes testaceous. Pronotum with disc sordid cream or light brownish, sometimes pinkish, rarely red, anterior and lateral margins yellow marked irregularly with cream, rarely uniformly sordid cream; scutellum yellow, sometimes marked



FIGS. 30–45. *Dikraneura carneola* (Stål). 30, head, pronotum and scutellum, dorsal view; 31, same; 32, same; 33, face; 34, head and pronotum, left lateral view; 35, female genitalia, ventral view; 36, left subgenital plate, ventral view; 37, male pygofer, valve and subgenital plates, left lateral view; 38, pygofer, posterior view; 39, abdominal apodemes, dorsal view; 40, aedeagus (Mammoth Lake, California), left lateral view; 41, aedeagus, posterior view in direction of arrow in previous fig.; 42, connective, anterodorsal view; 43, connective, left lateral view; 44, left style, dorsal view; 45, left style, left lateral view. Scale as in figs. 1–16.



FIGS. 46–58. *Dikraneura carneola* (Stål). 46, aedeagus (Weed, Siskiyou Co., California), left lateral view; 47, same (Baja California, Mexico); 48, same (Mammoth Lake, California); 49, same (Mammoth Lake, California); 50, same (Yosemite Valley, California); 51, same (Yosemite National Park, California); 52, same (Mammoth Lake, California); 53, same (Mammoth Lake, California); 54, same (Mammoth Lake, California); 55, aedeagus, posterior view in direction of arrow in previous fig.; 56, aedeagus (Yosemite National Park, California), left lateral view; 57, same (Mammoth Lake, California); 58, same (Yosemite National Park, California). Scale as in figs. 11–16.

irregularly with cream, rarely uniformly sordid cream; remainder of thorax dark brown, touched laterally with yellow. Legs pale stramineous. Fore wings with basal area subhyaline greenish yellow or light brownish, sometimes pinkish, rarely red, often pale; apical half hyaline with veins greenish yellow or cream, pinkish when base so coloured, sometimes pale smoky brown over apical cells. Hind wings hyaline with veins dark brown. Abdomen with dorsum and venter dark brown to black, former with lateral edge of posterior segments sometimes yellow, sternites with lateral and posterior borders sometimes yellow or whitish yellow; male pygofer and anal tube dark brown to black, valve dark brown, subgenital plates light brown, rarely whitish, yellowish or orange; female pygofer dark brown with narrow ventral edge bordering ovipositor cream, ovipositor cream with apex beyond pygofer dark brown, sternum VII cream with anterolateral angles dark brown.

Male apodemes short, decreasing gradually in length laterally, spoon-shaped, directed dorsoposteriorly, rarely posteriorly.

Male genitalia with pygofer as in *D. variata* Hardy but relatively shorter and more robust, with microspines absent or only weakly developed over small area. Aedeagus with preatrium and dorsally directed basal apodeme well developed; shaft directed dorsally, laterally compressed and tapering towards apex, terminating apically in a pair of short, narrow, dorsolaterally directed processes, their apices turned posteriorly, a pair of subapical processes on posterior margin directed anterolaterally, a pair of short triangular processes on anterior margin near base; gonopore elongate, on posterior margin between bases of posterior processes.

Female genitalia with sternum VII as in *D. variata* Hardy.

Distribution. Alaska (Stål, 1858*e*; Ashmead, 1904*a*), British Columbia (Gillette, 1898*a*; Ball & DeLong, 1925*a*; Downes, 1927*a*; Beirne, 1952*b*), Alberta (Strickland, 1953*a*), Ontario (Gibson, 1913*a*; Ball & DeLong, 1925*a*), Maine (Osborn, 1915*a*), South Dakota (Ball & DeLong, 1925*a*), Minnesota (Ball & DeLong, 1925*a*), Washington (Gillette, 1898*a*; Hatch, 1938*a*; Wolfe, 1955*c*), Oregon (Van Duzee, 1917*a*; McAtee, 1924*a*; Ball & DeLong, 1925*a*; Beirne, 1952*b*), Idaho (Ball & DeLong, 1925*a*; Knowlton & Allen, 1936*a*; Fox, 1938*a*; Barber, 1943*a*), California (Van Duzee, 1914*a*, 1916*b*, 1917*a*; Johnson & Ledig, 1918*a*; Ball & DeLong, 1925*a*; Beirne, 1952*b*), Utah (McAtee, 1924*a*; Ball & DeLong, 1925*a*; Knowlton, 1929*b*, 1931*b*; Knowlton & Allen, 1936*a*; Hayward, 1948*a*, 1952*a*; Knowlton, 1949*a*; Beirne, 1952*b*; Kaloostian, 1952*a*; Knowlton, 1953*b*), Colorado (Ball & DeLong, 1925*a*; Beirne, 1952*b*), Arizona (Gillette, 1898*a*; McAtee, 1924*a*; Ball & DeLong, 1925*a*), New Mexico (Ball & DeLong, 1925*a*), Mexico (Ball & DeLong, 1925*a*).

Specimens seen. CANADA: B. C., Grand Forks, 2 ♀, 14.v.1948 (*R. H. Handford*); B. C., Okanagan Falls, 2,500′, 1 ♂, 2 ♀, 16.vi.1953 (*J. R. McGillis*); B. C., Oliver, 1 ♂, 2 ♀, 18.vi.1953 (*J. R. McGillis*); B. C., Creston, 1 ♂, 9.ix.1948 (*D. B. Waddell*); Alta., Edmonton, 1 ♀, 15.vi.1937 (*F. O. Morrison*). UNITED STATES: Wash., Colokum Pass, 13 ♂, 3 ♀, 21.vii.1949 (*R. H. Beamer*); Wash., S. of Cheney, 6 ♂, 10 ♀, 9.vii.1935 (*Oman*); Wash., Mt. Ranier, Hells Crosng., 5 ♂, 14 ♀, 7.vii.1935 (*Oman*); Wash., Mt. Ranier, Cottnwd Flts., 2 ♀, 7.vii.1935 (*Oman*); Wash., Ritzville, 11 ♂, 13 ♀, 8.vii.1935 (*Oman*); Wash., Liberty, 4 ♂, 27.vii.1949 (*R. H. Beamer*); Wash., American River, 1 ♂, 29.vii.1949 (*R. H. Beamer*); Wash., S. of Spokane, 4 ♀, 9.vii.1935 (*Oman*); Wash., Palouse, Kamiak Butte, 5 ♀, 1.x.1918 (*A. C. Burrill*); Wash., Sprague, 1 ♂, 1 ♀, 20.vii.1949 (*R. H. Beamer*); Wash., Prosser, 1 ♂, 3 ♀, 8.vii.1935 (*Oman*); Wash., Cliffdell, 1 ♂, 7.vii.1935 (*Oman*); Ida., Coeur d'Alene, 3 ♂, 3 ♀, 9.vii.1935 (*Oman*); Ida., Butte Co., 2 miles N.E. Moore, 1 ♂, 10.ix.1957 (*G. W. Bishop*); Ida., Cataldo, 1 ♀, 9.vii.1935 (*Oman*); Ida.,

Moscow Mt., 1 ♂, 4.vi.1936 (*C. B. Philip*); Mont., Hamilton, 12 ♂, 19.vii.1949 (*R. H. Beamer*); Mont., 30 miles S. Darby, 1 ♂, 17.vii.1949 (*B. T. McDermott*); Mont., E. of Butte, 1 ♀, 11.vii.1935 (*Oman*); Ore., Mt. Hood, 30 ♂, 47 ♀, 3.vii.1935 (*Oman*); Ore., Criterion Pass, 5 ♂, 3 ♀, 2.vii.1935 (*Oman*); Ore., N. of Bend, 1 ♂, 1 ♀, 2.vii.1935 (*Oman*); Ore., S. of Bend, 1 ♀, 2.vii.1935 (*Oman*); Ore., Bend, 4 ♂, 6 ♀, 2.vii.1935 (*Oman*); Ore., Lapine, 4 ♂, 7 ♀, 2.vii.1935 (*Oman*); Ore., Klamath Ag., 1 ♂, 6 ♀, 1.vii.1935 (*Oman*); Ore., Crater Lake Natl. Park, El. 6,500′, 2 ♂, 5 ♀, 23.vii.1949 (*E. L. Atkinson*); Ore., Klamath Co., Algoma, El. 4,100′, 7 ♂, 3 ♀, 22.vii.1949 (*E. L. Atkinson*); Ore., Pendleton, 2 ♂, 14.vii.31 (*M. W. Sanderson*); Ore., Bonneville, 1 ♀, 4.vii.1935 (*Oman*); Ore., Meacham, 1 ♂, 14.vii.31 (*R. H. Beamer*); Ore., Haines, 2 ♂, 10.vii.31 (*R. H. Beamer*); Ore., Anthony Lake, 1 ♂, 11.vii.31 (*J. Nottingham*); Ore., Cove, 1 ♂, 8.viii.1927 (*H. E. Wallace*); Ore., Astoria, 1 ♀, ix.22 (*no collector*); Ore., S. of Worden, 1 ♀, 1.vii.1935 (*Oman*); Ore., Sun Pass, 1 ♂, 1.vii.35 (*R. H. Beamer*); Cal., Alpine Co., Carson Pass, 4 ♂, 4 ♀, 29.vi.57 (*J. Powell*); Cal., Inyo Co., Mono Pass, 2 ♂, 13.viii.57 (*J. Powell*); Cal., Tuolumne Co., Chipmunk Flat, 3 ♂, 4 ♀, 13.vi.62 (*J. Powell*); Cal., Tioga Pass, 3 ♂, 7 ♀, 31.vii.1940 (*L. J. Lipovsky*), 1 ♂, 31.vii.40 (*D. E. Hardy*); Cal., Ventura Co., Mt. Pinos, 7,500′, 1 ♂, 2 ♀, 8.v.59 (*G. I. Stage*), 1 ♂, 8.v.59 (*C. W. O'Brien*); Cal., Modoc Co., Cedar Pass, 3 ♂, 3 ♀, 29.vi.55 (*J. W. MacSwain*); Cal., Sequoia Nat. Pk., 5 ♂, 4 ♀, 6.viii.40 (*D. E. Hardy*); Cal., Bishop, 3 ♂, 1 ♀, 28.vii.40 (*L. J. Lipovsky*), 1 ♀, 28.vii.40 (*D. E. Hardy*); Cal., San Jacinto Mts., Idyllwild, 1 ♂, 1 ♀, 22.v.1940 (*C. D. Michener*); Cal., Siskiyou Co., 24 miles N. Weed, 1 ♂, 24.vii.1949, 7 ♂, 6 ♀, 23.vii.1949 (*E. L. Atkinson*); Cal., Siskiyou Co., 12 miles S. Dorris, 1 ♂, 23.vii.1949 (*E. L. Atkinson*); Cal., San Jacinto Mts., 2 ♂, 1 ♀, 20.vii.41, 1 ♂, 21.vii.29, 1 ♂, 30.vi.33 (*R. H. Beamer*); Cal., San Jacinto Mts., Tahquitz Valley, 1 ♀, 3.vi.1940 (*C. D. Michener*); Cal., San Jacinto Mts., Pinon Flat, 1 ♂, 21.v.1940 (*C. D. Michener*); Cal., Shasta Co., Kings Crk Mdw., 1 ♀, 2.vii.1947 (*C. A. Hanson*); Cal., Yucaipa, 3 ♂, 8.iv.39 (*Christensen*); Cal., San Gabriel, 1 ♀, 7.vii.26 (*no collector*); Cal., Giant Forest, 5 ♂, 28.vii.29 (*R. H. Beamer*); Cal., Lone Pine, 1 ♀, 28.vii.1940 (*D. E. Hardy*); Cal., Eldorado Co., Pyramid R. S., 1 ♂, 12.vii.48 (*S. A. Sher*); Cal., Little Lake, 1 ♂, 25.vii.1940 (*D. E. Hardy*); Cal., Mariposa Co., Miama Ranger Sta., 1 ♀, 22.vi.1942 (*A. J. Walz*); Cal., Big Bear Lake, 1 ♂, 26.vii.32 (*R. H. Beamer*); Cal., Davis, 1 ♂, 19.iii.1958 (*E. Jessen*); Cal., 3 miles S.E. Mt. Lassen, 2 ♂, 3 ♀, 8.vii.55 (*J. W. MacSwain*); Cal., Tulare Co., Wood L., 1 ♀, 22.iii.1947 (*N. W. Frazier*); Cal., Tahoe, G. Alpine Cr., 1 ♂, 23.vi.15, 1 ♀, 3.x.15 (*E. P. Van Duzee*); Cal., Tahoe, Angora L., 1 ♀, 22.vi.15 (*E. P. Van Duzee*); Cal., Tahoe, Grass Lake, 1 ♀, 24.vi.15 (*E. P. Van Duzee*); Cal., 2 miles E. of Ineber Lake, 1 ♂, no date (*no collector*); Cal., Madera Co., Jackass Meadow, 1 ♂, 31.vii.1946 (*T. O. Thatcher*); Cal., Glenn Co., Plaskett Mdws., 6,200′, 1 ♂, 2 ♀, 3.vii.60 (*J. Powell*); Cal., Guatay, 1 ♂, 21.vii.41 (*E. L. Todd*); Cal., Echo, 9 ♂, 8 ♀, 10.viii.1940 (*L. J. Lipovsky*); Cal., Mammoth Lake, 20 ♂, 13 ♀, 29.vii.1940 (*D. E. Hardy*), 3 ♂, 2 ♀, 29.vii.1940 (*L. J. Lipovsky*), 1 ♂, 29.vii.40 (*R. H. Beamer*); Cal., Mono Lake, 2 ♂, 31.vii.40 (*D. E. Hardy*); Cal., Mono Co., Sonora Pass, McKay Creek, 2 ♀, 18.viii.60 (*E. Jessen*); Cal., Yosemite Nat. Pk., 21 ♂, 22 ♀, 1.viii.1940 (*L. J. Lipovsky*), 10 ♂, 14 ♀, 1.viii.1940 (*D. E. Hardy*), 2 ♂, 1.viii.40 (*L. C. Kuitert*), 1 ♂, 1.viii.40 (*R. H.*

Beamer); Cal., Yosemite Valley, 1 ♂, 10.vii.33 (*R. H. Beamer*); Cal., Yosemite, 3,880′–4,000′, 1 ♂, 19.v.1938 (*N. F. Hardman*); Utah, Provo Canyon, 4 ♂, 3 ♀, 15.viii.40 (*D. E. Hardy*); Utah, Provo, 1 ♂, xi.192– (*D. Elden Beck*); Utah, Smithfield, 1 ♀, 13.vii.1935 (*Oman*); Utah, Strwbry Dam, 13 ♀, 16.vii.1935 (*Oman*); Utah, Farmington, 2 ♂, 1 ♀, 10.x.1953 (*G. F. Knowlton*); Utah, Cotton, 1 ♂, 4 ♀, 22.vi.43 (*S. F. Knowlton*); Utah, Wanship, 2 ♂, 2 ♀, 28.vi.43 (*S. F. Knowlton*); Utah Exp. St., 1 ♂, no date (*G. F. Knowlton*); Utah, Park City, 1 ♂, 1.viii.1947 (*R. H. Beamer*); Utah, Fish Lake, 1 ♂, 16.viii.29 (*R. H. Beamer*), 1 ♀, 2.ix.30 (*no collector*); Utah, Heber, 1 ♂, 17.viii.40 (*R. H. Beamer*); Utah, Midvale, 1 ♂, 1 ♀, 10.x.1953 (*G. F. Knowlton*); Utah, Naples, 1 ♂, 28.vi.43 (*G. F. Knowlton*); Utah, Willow Creek, 1 ♀, 27.vi.43 (*S. F. Knowlton*); Colo., Craig, 1 ♂, 3.viii.1947 (*R. H. Beamer*); Nev., Ormsby Co., 1 ♀, vii (*Baker*); Nev., Carson City, 1 ♂, 9.viii.29 (*R. H. Beamer*). MEXICO: Baja Calif., Sierra San Pedro Martir, 2 miles W. La Sanja, 6,500′, 2 ♂, 2.vi.58 (*J. Powell*); Baja Calif., Sierra San Pedro Martir, 3 miles S. Encinas, 1 ♂, 1 ♀, 3.vi.58 (*J. Powell*); Baja Calif., Sierra San Pedro Martir, 4 miles S. Encinas, 6,000′, 1 ♀, 2.vi.58 (*J. Powell*); Baja Calif., Sierra San Pedro Martir, 5 miles N.E. Encantada, 9,000′, 11 ♂, 8 ♀, 31.v.58 (*J. Powell*); Baja Calif., Sierra San Pedro Martir, La Grulla, 6,500′, 19 ♂, 3 ♀, 28.v.58, 7 ♂, 16 ♀, 29.v.58, 1 ♀, 1.vi.58 (*J. Powell*).

New Records: Montana, Nevada.

Dikraneura carneola was originally described by Stål from Sitka, Alaska. Unfortunately, this was restricted to only colour and wing venation which alone are insufficient to characterize the species concerned. Beirne (1952*b*) draws attention to this fact and queries whether the *carneola* of American authors is in fact the *carneola* of Stål. The male holotype, stated by Stål (1958*e*) to be in his personal collection, could not be located in the latter in the Naturhistoriska Riksmuseum in Stockholm.[1] Attempts to locate it in the Naturhistorisches Museum, Vienna, were likewise without success.[2] Unfortunately, the species *D. absenta* DeLong & Caldwell, *D. variata* Hardy, *D. ossia* Beirne, *D. mali* (Provancher) and *D. shoshone* Delong & Caldwell, as well as *carneola*, all extend over the northwestern region of N. America and fit the original description so that any one of these species might conceivably have been taken by Stål. However, in order to avoid unnecessary nomenclatorial confusion, it was decided to follow the *carneola* of authors. The absence of suitable topotypic material prevents the designation of a neotype.

One male and one female of *Dikraneura carneola* var. *sitkana* labelled " Logan, Utah, 6–20–08 " " Paratype " together with 1 ♂ labelled " Salt Lake, Utah, 6–16–98 " were also studied. All three specimens are located in the U.S.N.M.

Biology. *Dikraneura carneola* is a very common species present from early spring to late summer throughout its range. Its earliest recorded occurrence is April in California (Van Duzee, 1914*a*) although specimens at hand show it to be active in this state as early as March. Its latest recorded occurrence is October in Utah (McAtee, 1924*a*; Knowlton, 1931*b*, 1953*b*), this month being indicated also in specimens at

[1] Dr. E. Kjellander, in correspondence.
[2] Dr. M. Beier, in correspondence.

hand from Washington, California and Utah while November is seen to be the latest for the latter state. It occurs on grasses (Osborn, 1915*a*; Van Duzee, 1916*b*; Ball & DeLong, 1925*a*; Downes, 1927*a*; Hayward, 1952*a*; Wolfe, 1955*c*), oats (Osborn, 1915*a*; Wolfe, 1955*c*), wheat (Osborn, 1915*a*; Wolfe, 1955*c*; Knowlton, 1949*a*), weeds (Fox, 1938*a*; Wolfe, 1955*c*), alfalfa (Hatch, 1938*a*; Wolfe, 1955*c*; Knowlton, 1953*b*), beets (Knowlton & Allen, 1936*a*), potato (Knowlton & Allen, 1936*a*; Wolfe, 1955*c*), clover (Wolfe, 1955*c*), sweet corn (Barber, 1943*a*) and matrimony vine (Knowlton & Allen, 1936*a*). Its specific host plants include *Gutierrezia* sp. (Knowlton, 1931*b*), *Chrysothamnus* sp., *Atriplex rosea* L., *Sophia sophia* (L.) and *Salsola pestifer* Nelson (Knowlton & Allen, 1936*a*). Wolfe (1955*c*) grades the host plants according to their importance, with *Medicago sativa* L. (alfalfa), *Prunus avium* L. (sweet cherry), *Prunus persica* Batsch (peach), *Solanum tuberosum* L. (potato) and various species of weeds as accidental associations only, *Avena sativa* L. (oats), *Hordeum* sp. (barley), *Secale cereale* L. (rye), *Triticum aestivum* L. (wheat) as food plants and with various species of grasses providing the only hosts for oviposition and nymphal development. *D. carneola* is considered as a common meadow form (Ball & DeLong, 1925*a*), abundant in wet swampy meadows (Van Duzee, 1916*b*; Hayward, 1952*a*). Kaloostian (1952*a*) records it in moderate numbers in stone fruit orchards in Utah and Hayward (1948*a*) in his study of the Wasatch Chaparral community in Utah records it in the herb-low shrub layer at 5,200′–6,800′. Glick (1939*a*), in his study of the distribution of insects in the air, collected it at 2,000′ at night. Wolfe (1955*c*) considers it as one of the most important species in Washington, causing damage to alfalfa, clover, grains and grasses as well as infesting lawns. It is also considered an injurious species on grasses, oats and wheat in Maine (Osborn, 1915*a*). It has been found injuring the leaves of sweet corn in Idaho (Barber, 1943*a*) as well as producing tiny-spot leaf discoloration injury to alfalfa in Utah (Knowlton, 1953*b*). Kaloostian (1952*a*) reports it as responsible, with other species, for the transmission of the Western X-disease virus of stone fruits in Utah.

Remarks. *Dikraneura carneola* shows a certain variability in the shape of the aedeagus (Text-figs. 40 and 46–58) even among individuals from the same locality (cf. Text-figs. 40, 48, 49, 52, 53, 54 and 57, from Mammoth Lakes, California, and Text-figs. 51, 56 and 58 from the Yosemite National Park, California). The most common forms are those shown in Text-figs. 40, 46, 48, 51, 53 and 54. This species is very closely related to *D. variata* Hardy and is further discussed under the latter species.

Dikraneura absenta DeLong & Caldwell

(Text-figs. 59–74)

Dikraneura (*Notus*) *absenta* DeLong & Caldwell, 1937*a* : 28.
Dikraneura (*Notus*) *termina* DeLong & Caldwell, 1937*a* : 29. **syn. n.**
Dikraneura feirde Beirne, 1952*b* : 252. **syn. n.**

Length: ♂ 3·38–3·92 mm. (mean 3·63 mm.). ♀ 3·40–4·10 mm. (mean 3·78 mm.).

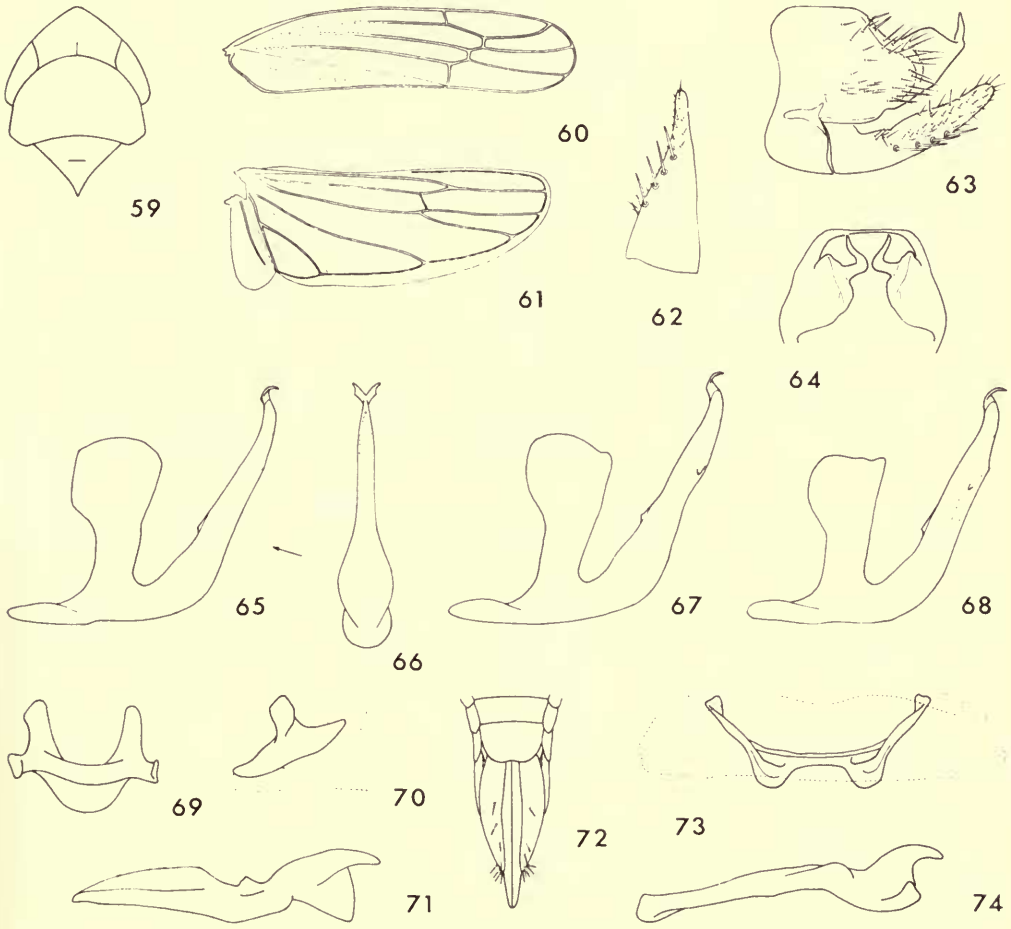
Form and colour as in *D. carneola* (Stål) but with vertex usually more broadly rounded in profile and dorsal aspect, with head more yellowish, small creamish patch above antenna and

that between marginal sutures less distinct, the midline of the pronotum often paler and with ventral surface of abdomen and female pygofer pale yellow or cream.

Male apodemes short, poorly developed, directed dorsoposteriorly, not spoon-shaped.

Male genitalia with pygofer as in *D. variata* Hardy but with pygofer relatively shorter and more robust and with microspines absent or only weakly developed over small area. Aedeagus as in *D. carneola* (Stål) but without subapical processes on posterior margin, with apical processes relatively shorter and with triangular processes on anterior margin very small.

Female genitalia with sternum VII as in *D. variata* Hardy.



FIGS. 59–74. *Dikraneura absenta* DeLong & Caldwell. 59, head, pronotum and scutellum, dorsal view; 60, fore wing; 61, hind wing; 62, left subgenital plate, ventral view; 63, male pygofer, valve and subgenital plate, left lateral view; 64, male pygofer, posterior view; 65, aedeagus, left lateral view; 66, aedeagus, posterior view in direction of arrow in fig. 65; 67, aedeagus, left lateral view; 68, same; 69, connective, anterodorsal view; 70, connective, left lateral view; 71, left style, dorsal view; 72, female genitalia, ventral view; 73, abdominal apodemes, dorsal view; 74, left style, left lateral view. Scale as in figs. 1–16.

Distribution. British Columbia (DeLong & Caldwell, 1937*a*; Beirne, 1952*b*), Washington (DeLong & Caldwell, 1937*a*; Wolfe, 1955*c*), Oregon, Idaho, Utah, Colorado, California and Arizona (DeLong & Caldwell, 1937*a*).

Specimens seen. CANADA: B. C., Summerland, 1 ♀, 18.vi.31, 1 ♂, 2 ♀, 10.ix.31 (*A. N. Gartrell*), 2 ♀, 11.vii.50 (*B. P. Beirne*); B. C., Kool Bay, 1 ♂, 21.ix.1948 (*D. B. Waddell*); B. C., Abbotsford, 1 ♀, 6.ix.50 (*no collector*); B. C., MacGillivray Creek Game Reserve, nr. Chilliwack, 1 ♂, 14.vii.1953 (*G. J. Spencer*); B. C., Creston, 2 ♂, 1 ♀, 9.ix.1948 (*D. B. Waddell*); B. C., Shuswap Lake, 1 ♀, 22.vii.1926 (*J. McDunnough*); B. C., Goldstream, 1 ♂, 7.vii.50 (*B. P. Beirne*); B. C., Willow Pt., 1 ♂, 1 ♀, 2.vii.1948 (*D. B. Waddell*). UNITED STATES: Wash., Kalama, 7 ♂, 12 ♀, 4.vii.1935 (*Oman*); Wash., Puyallup, 4 ♂, 14 ♀, 6.vii.1935, 2 ♂, 9 ♀, 5.vii.1935 (*Oman*); Wash., Mt. Ranier, Cottnwd Flts., 2 ♂, 4 ♀, 7.vii.1935 (*Oman*); Wash., Mt. Ranier, Hells Crosng., 2 ♀, 7.vii.1935 (*Oman*); Wash., Ft. Lewis, 1 ♂, 5.vii.1935 (*Oman*); Wash., Buckley, 1 ♂, 4 ♀, 6.vii.1935 (*Oman*); Wash., Randle, 2 ♂, 1 ♀, 22.vii.1949 (*J. R. White*); Wash., Ritzville, 1 ♀, 8.vii.1935 (*Oman*); Wash., Sprague, 1 ♂, 20.vii.1949 (*R. H. Beamer*); Ore., S. of Worden, 16 ♂, 14 ♀, 1.vii.1935 (*Oman*); Ore., Bonneville, 5 ♂, 16 ♀, 4.vii.1935 (*Oman*); Ore., Bend, 3 ♂, 2.vii.1935 (*Oman*); Ore., S. of Bend, 1 ♀, 2.vii.1935 (*Oman*); Ore., Klamath Co., Algoma, El. 4,100′, 1 ♂, 2 ♀, 22.vii.1949 (*E. L. Atkinson*); Ore., Klamath Falls, 1 ♀, 1.vii.1935 (*Oman*); Ore., Yoncalla, 1 ♂, 12.vii.35 (*R. H. Beamer*); Ida., Butte, 1 ♂, 26.viii.38 (*no collector*); Ida., Cataldo, 2 ♂, 1 ♀, 9.vii.1935 (*Oman*); Ida., Coeur d'Alene, 3 ♂, 8 ♀, 9.vii.1935 (*Oman*); Mont., W. of Manhatn., 2 ♂, 1 ♀, 11.vii.1935 (*Oman*); Cal., Siskiyou Co., Gazelle, 1 ♀, 24.vi.58 (*J. Powell*); Cal., Mt. St. Helena, Hanleys, 1 ♀, 3.v.1947 (*T. O. Thatcher*); Cal., Modesto, 1 ♀, 29.v.1939, 1 ♀, 19.v.1942, 2 ♂, 2 ♀, 14.vi.1942 (*no collector*); Cal., Taft, 2 ♀, 19.v.1942, 1 ♂, 20.vi.1942 (*no collector*); Cal., Onyx, 1 ♀, 23.vii.40 (*R. H. Beamer*); Cal., Campo, 3 ♀, 18.vii.40 (*D. E. Hardy*); Cal., Sequoia Nat. Pk., 2 ♂, 6.viii.1940 (*D. E. Hardy*); Cal., Inyo Co., Owens Valley, 1 ♀, 19.v.1937 (*no collector*); Cal., Modoc Co., 7 miles S.E. Tule Lake, 1 ♀, no date (*R. F. Smith*); Cal., La Jolla, 1 ♂, 6 ♀, 14.vii.41 (*R. H. Beamer*); Cal., Contra Costa Co., Antioch, 2 ♀, 6.iv.56 (*M. Wasbauer*); Cal., Berkeley, 1 ♂, 1 ♀, x.1914, 2 ♀, ix.1914 (*E. P. Van Duzee*); Cal., Davis, 1 ♀, 17.vii.1936, 1 ♀, vii.1937 (*no collector*); Nev., Austin, 1 ♂, 12.viii.1940 (*D. E. Hardy*); Utah, Wanship, 1 ♂, 28.vi.43 (*S. F. Knowlton*); Ariz., White Mts., 16 ♂, 19.vi.1950 (*R. H. Beamer*); Ariz., Granite Dells, 23 ♂, 3 ♀, 3.vii.1950 (*R. H. Beamer*); Ariz., Oak Creek Cn., 1 ♀, 26.vi.1950 (*R. H. Beamer*); Ariz., Santa Rita Mts., 2 ♂, 10.vii.1950 (*R. H. Beamer*); N. M., Mountain Park, 1 ♂, 2 ♀, 27.vi.40 (*D. E. Hardy*).

New Records: Montana, Nevada, New Mexico. A single specimen from the Canal Zone is present in the Osborn Collection, Ohio State University.

The holotype ♂ (UNITED STATES: Ida., Craters of Moon, 29.vi.30 (*no collector*)), allotype ♀ (UNITED STATES: Wash., Kalama R., 21.vii.31 (*R. H. Beamer*)) and 10 paratypes (CANADA: B. C., Kelowna, 1 ♂, 1 ♀, 5.viii.31 (*R. H. Beamer*); B. C., Merritt, 1 ♀, 3.viii.31 (*J. Nottingham*); B. C., Merritt, 1 ♀, 3.viii.31 (*R. H. Beamer*). UNITED STATES: Cal., Donner Lake, 1 ♂, 6.viii.30 (*no collector*); Cal., Strawberry, 1 ♂, 8.viii.29 (*R. H. Beamer*); Ariz., Oak Creek Cn., 1 ♂, 9.viii.32 (*R. H. Beamer*);

Utah, Lehi, 1 ♂, 3.viii.06 (*no collector*); Idaho, Bliss, 2 ♀, 7.vii.31 (*H. T. Peters*)), located in the DeLong Collection, Ohio State University, were studied. The holotype and the male paratype from Oak Creek Canyon, Arizona, were missing from their points although their genitalia were still present in the vials. The date of the holotype and the locality of the allotype differ from that given in the original description.

The holotype ♂, allotype ♀ and 1 ♂, 1 ♀ paratype (UNITED STATES: Ariz., Oak Creek Cn., 9.viii.32 (*R. H. Beamer*)) of *Dikraneura termina* DeLong & Caldwell, located in the Snow Museum, University of Kansas, were studied. 1 ♂, 1♀ paratype (same data as holotype) and 1 ♀ paratype (UNITED STATES: Ariz., Oak Creek Cn., 31.vii.33 (*R. H. Beamer*)), in the DeLong Collection, were also studied. The vial associated with the holotype contains two abdomens, one of which is *D. absenta* and the other completely membranous and abnormal in shape, lacking posterior processes on the pygofer and with the aedeagus simple and tapered towards its apex as illustrated in the original description. The species described by DeLong & Caldwell as *D. termina* is undoubtedly a combination of these two specimens, the pygofer of *D. absenta* being associated with the aedeagus of the abnormal specimen. Since the perfect specimen associated with the holotype, and partially included in the original description, is *D. absenta* it is interpreted as the holotype and *D. termina* placed as a synonym of *D. absenta* which has page priority. As all members of the type series except one (a female) were taken together it may be confidently assumed that the abnormal specimen is associated with the other specimens and therefore rightfully belongs to *D. absenta*. The abdomens of the two male paratypes are missing.

The type series of *D. feirde* Beirne, located in the Canadian National Collection in Ottawa, is a mixed series of both *D. feirde*, as originally described, and *D. absenta*. The male genitalia associated with the holotype (CANADA: B. C., Summerland, 10.ix.1931 (*A. N. Gartrell*)) and one paratype (CANADA: B. C., Oliver, 23.v.1923 (*C. B. Garrett*)) are of *D. absenta* and do not agree with the original description of *D. feirde*. The remaining two paratypes are identical to the description of *D. feirde*, which however is the same as *D. shoshone* DeLong & Caldwell.

Biology. The recorded occurrence of *Dikraneura absenta* is limited to June and July in Idaho and Washington respectively (DeLong & Caldwell, 1937*a*) although material at hand shows it to be active from April to October in California. In Washington it is usually found on grasses although its hosts also include *Ambrosia* sp. (ragweed), *Medicago sativa* L. (alfalfa) and weeds (Wolfe, 1955*c*). The last three are considered however as accidental associations only while grasses alone afford host plants for both food and nymphal development. It is one of the most important leafhoppers in Washington causing damage to alfalfa, clover, grains and grasses and occasionally infests lawns. It is also reported (Beirne, 1952*b*) as a common species in parts of British Columbia.

Remarks. *Dikraneura absenta* is closely related to *D. carneola* (Stål), differing from the latter mainly by the absence of posterior subapical processes on the aedeagus and by the less well developed abdominal apodemes. Its close relationship to

D. carneola can be further seen by the presence in some individuals of short peg-like processes situated posterolaterally on the shaft just basad of the gonopore (Text-figs. 67 and 68). Such individuals occur in the same populations as those without these pegs, indicating the individual rather than clinal nature of this character. Externally, these two species, although very similar, may be separated by the presence in *D. absenta* of a usually more obtusely angled vertex, a pale yellow or cream venter to the abdomen and female pygofer, the often paler medial area of the pronotum and the much less distinct patch above the antenna and marginal patch between the sutures.

The external separation of *D. absenta* and the Nearctic forms of *D. variata* Hardy is more difficult. *D. variata* however is usually much paler with the ventral surface of the abdomen dark brown, although a dark brown suffusion over the anterior half of the abdominal sternites in some specimens of *D. absenta* makes this latter character unreliable.

Dikraneura aridella (Sahlberg)

(Text-figs. 75–86)

Typhlocyba citrinella Flor (*nec* Zetterstedt), 1861*a* : 386.
Notus aridellus Sahlberg, 1871*a* : 167.
Notus cephalotes Fieber, 1872*a* : 14 [nom. nud.].
Notus cephalotes Lethierry, 1874*a* : 272.

Length: ♂ 3·12–3·14 mm. (mean (3·13 mm.). ♀ 2·96–3·24 mm. (mean 3·12 mm.).

Similar to *D. variata* Hardy but with aedeagus distad of gonopore narrower and more elongate and with posterior processes extending anteriorly to level of posterior margin of basal apodeme.

Distribution. FINLAND (Sahlberg, 1871*a*; Ossiannilsson, 1946*c*; Lindberg, 1947*a*; Kontkanen, 1948, 1949*c*, 1952*b*; Linnavuori, 1949*a*, 1952*a*, *e*), SWEDEN (Sahlberg, 1871*a*; Ossiannilsson, 1934*a*, 1941*d*, 1946*c*; Kontkanen, 1948), NORWAY (Kontkanen, 1948), ENGLAND (Fieber, 1872*a*), DENMARK (Jacobsen, 1915*a*; Jensen-Haarup, 1918*b*, 1920*a*), BELGIUM (Lethierry, 1878*c*, 1892*b*), FRANCE (Lethierry, 1874*a*), GERMANY (Kirschbaum, 1868*b*; Melichar, 1896*a*), Prussia (Kirschbaum, 1868*b*; Matsumura, 1906*a*) and AUSTRIA (Löw, 1886*a*; Melichar, 1896*a*).

Specimens seen. SWEDEN: Östergötland, Vist, Sturefors, 1 ♂, 27.viii.32 (*Ossiannilsson*); Östergötland, Kimstad, 1 ♂, 13.vi.34 (*Ossiannilsson*); Östergötland, Rystad, Luestad, 1 ♀, 30.v.34 (*Ossiannilsson*); Östergötland, Rystad, Frösta, 1 ♀, 6.vi.33 (*Ossiannilsson*); Östergötland, Askeby, 1 ♀, 7.vi.32 (*Ossiannilsson*); Dalarne, Malingsbo, 1 ♂, 15.vii.1941 (*Ossiannilsson*).

The type series of *D. aridella*, located in the Universitetets Zoologiska Museum, Helsinki, consists of three specimens of which one is a female, another is a parasitized male and the third has its abdomen missing.[3] The male, labelled " Kuopio, Reinikainen ", was studied. Unfortunately, as a result of its condition, the abdominal apodemes are absent, the anterior halves of the styles and the connective membraneous and the aedeagus small and abnormal in shape, characters typical of

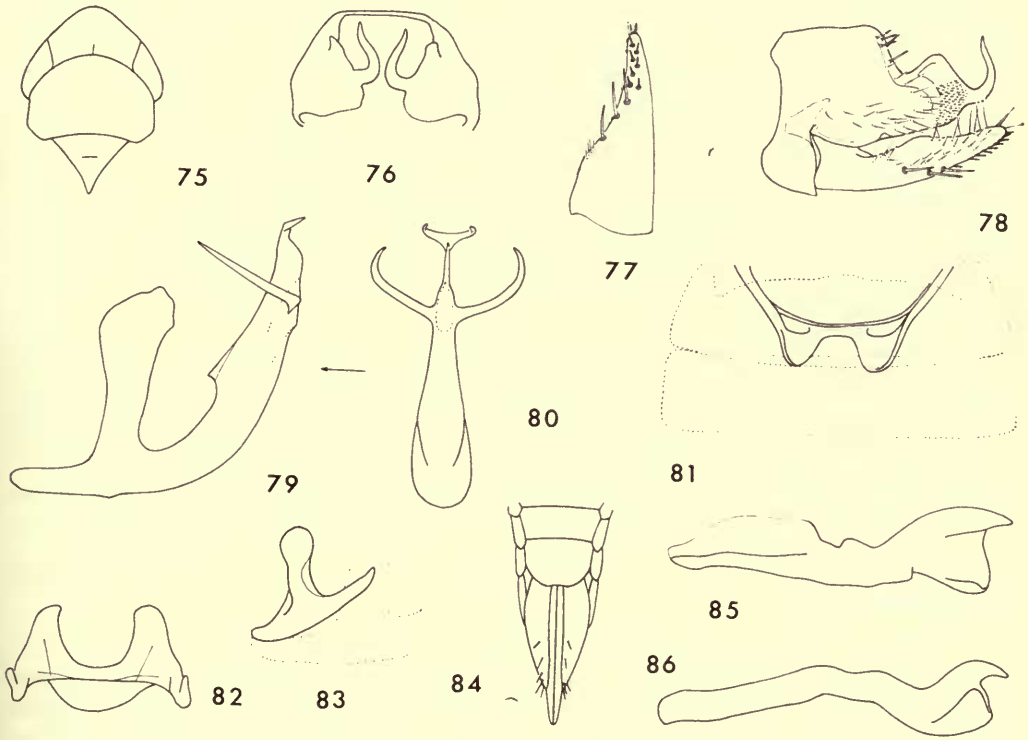
[3] Dr. M. Meinander, in correspondence

parasitized males. The pygofer and subgenital plates were normal. A lectotype was not selected.

The holotype of *Notus cephalotes* Lethierry was not studied.

Biology. *Dikraneura aridella* appears to be active from early to late summer, its earliest recorded occurrence being in May (Lethierry, 1874*a*) and its latest in September (Jacobsen, 1915*a*; Jensen-Haarup, 1920*a*). Material at hand would also suggest a similar period of activity. It inhabits dry grass meadows (Flor, 1861*a*; Lindberg, 1947*a*) although it has also been found, although rare, in both rich swampy woods and rich moist grass herb woods (Linnavuori, 1952*a*). It apparently overwinters as the adult (Lindberg, 1947*a*).

Remarks. *Dikraneura aridella* is closely related to the only other European member of the genus, *D. variata* Hardy. The two species are identical externally and for many years were considered synonymous. The male genitalia are also similar with the exception of the aedeagus, which in *D. aridella* is narrower apically



FIGS. 75–86. *Dikraneura aridella* (Sahlberg). 75, head, pronotum and scutellum, dorsal view; 76, male pygofer, posterior view; 77, left subgenital plate, ventral view; 78, male pygofer, valve and subgenital plate, left lateral view; 79, aedeagus, left lateral view; 80, aedeagus, posterior view in direction of arrow in fig. 79; 81, abdominal apodemes, dorsal view; 82, connective, anterodorsal view; 83, connective, left lateral view; 84, female genitalia, ventral view; 85, left style, dorsal view; 86, left style, left lateral view. Scale as in figs. 1.–16.

in lateral aspect, with the posterior processes more elongate and reaching to near the level of the posterior edge of the basal apodeme.

Dikraneura omani sp. n.

(Text-figs. 87–99)

Length: ♂ 3·62–4·18 mm. (mean 3·90 mm.). ♀ 4·14–4·28 mm. (mean 4·20 mm.).

Head with width equal to or slightly narrower than that of pronotum, vertex angularly produced with apex narrowly rounded in dorsal aspect, medial length 1¾–2 times length next eyes, narrowly rounded to face with latter slightly longer than wide, ocellocular area slightly wider than antennal fossa; pronotum with width increasing posteriorly.

Colour of face sordid cream or pale smoky brown, paling to cream laterally on genae, a small patch usually present above antenna pale whitish, vertex and pronotum whitish cream, with broad discal area of latter faintly sordid or pale brownish, sometimes pinkish, a broad band on each side of midline extending and increasing in width from apex of vertex to posterior margin of pronotum greenish yellow or orange-yellow, rarely deep orange or reddish, rarely indistinct; eyes testaceous. Scutellum yellow marked with cream; remainder of thorax dark brown marked laterally with yellow. Legs pale stramineous. Fore wings with basal area subhyaline greenish yellow, often sordid, sometimes reddish, claval vein, claval suture and *Cu* to base of apical cells sometimes whitish; apical half hyaline, often smoky brown, with veins yellowish, paling to cream apically. Hind wings hyaline with veins dark brown. Abdomen with dorsum and venter dark brown to black, with lateral margins of former, especially on posterior segments, pale fawn or yellow, sternites with lateral and posterior edges, or rarely entire sclerite, whitish or fawn; male pygofer and anal tube dark brown, valve pale fawn, rarely brown, subgenital plates pale fawn; female pygofer cream or pale brownish with dorsum and apex of ovipositor beyond pygofer dark brown, sternum VII concolorous with pygofer.

Male apodemes elongate, each with length approximately twice width, extending to posterior region of fourth segment.

Male genitalia with pygofer as in *D. variata* Hardy but with hair-like setae on lateral surface much fewer in number and with microspines restricted to posteroventral area. Aedeagus with preatrium and dorsally directed basal apodeme well developed, the latter expanding apically; shaft directed dorsally, tapering towards apex and terminating in a pair of narrow dorsally directed processes, their apices turned posteriorly; a pair of processes laterally near midlength, directed anterolaterally; gonopore elongate over distal half of posterior margin of shaft.

Female genitalia with lateral margins of sternum VII converging posteriorly, with posterior margin strongly produced with medial third transverse or sometimes slightly concave.

Holotype ♂. UNITED STATES: Ida., Coeur d'Alene, 9.vii.1935 (*Oman*), in U.S. National Museum.

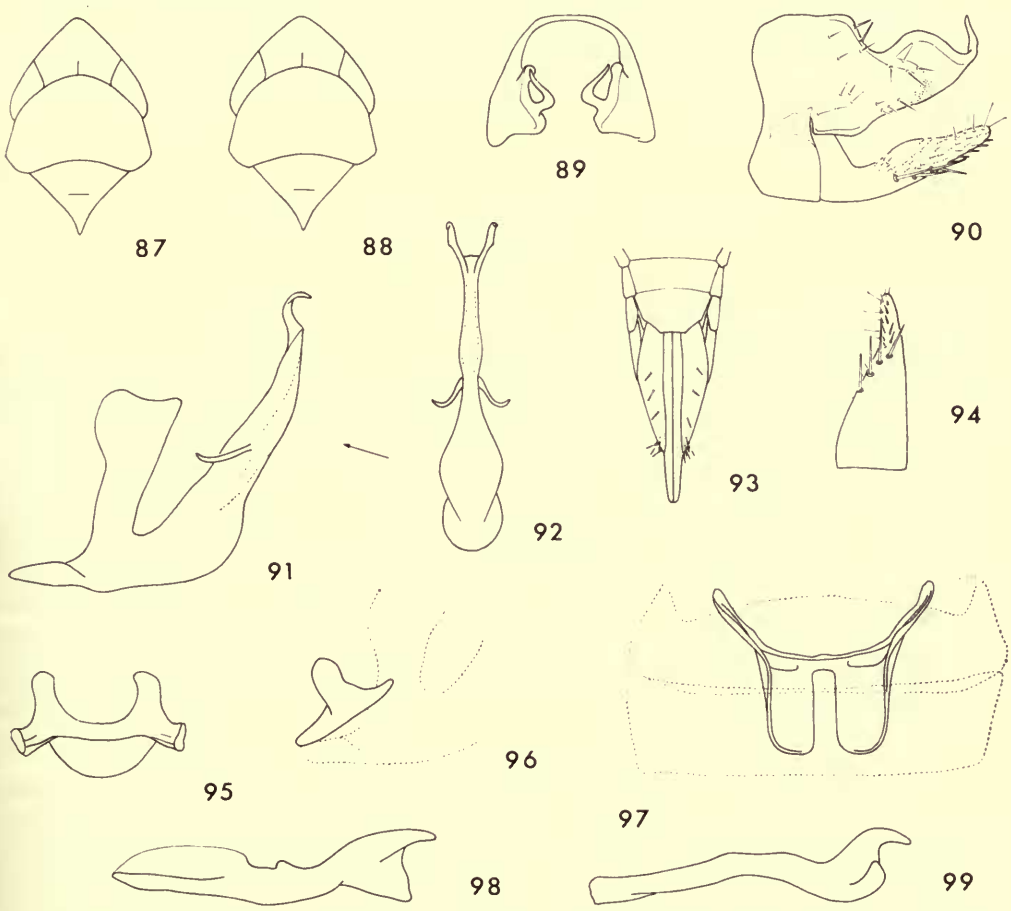
Allotype ♀. Same data as holotype, in U.S. National Museum.

Paratypes. UNITED STATES: 2 ♂, 5 ♀, same data as holotype, in U.S. National Museum; Ore., Bonneville, 2 ♂, 4.vii.1935 (*Oman*), in U.S. National Museum; Wash., Cliffdell, 1 ♂, 7.vii.1935 (*Oman*), in U.S. National Museum; Cal., Yosemite Nat. Pk., 1 ♂, 1 ♀, 1.viii.1940 (*D. E. Hardy*), in Snow Museum, University of Kansas; Cal., Yosemite Nat. Pk., 1 ♀, 1.viii.40 (*L. C. Kuitert*), in Snow Museum, University of Kansas; Cal., Yosemite Valley, 1 ♂, 10.vii.33 (*R. H. Beamer*), in DeLong Collection, Ohio State University; Cal., Yosemite, 3,880′–4,000′, 1 ♀, 21.v.1931 (*E. O. Essig*), in University of California, Berkeley; Cal., San Jacinto Mts., Idyllwild, 1 ♂, 22.v.1940 (*C. D. Michener*), in University of California, Berkeley; Cal., Sequoia Nat.

Pk., 1 ♂, 1 ♀, 6.viii.40 (*D. E. Hardy*), in Snow Museum, University of Kansas; Cal., Tulare Co., 1 ♂, 29.vii.29 (*R. H. Beamer*), in DeLong Collection, Ohio State University; Cal., Leona Heights, 1 ♀, 15.vii.33 (*R. H. Beamer*), in DeLong Collection, Ohio State University; CANADA: B. C., Victoria, 1 ♀, 9.vii.1923 (*K. F. Auden*), in Canadian National Collection, Ottawa.

This species is named in honour of Dr. P. W. Oman, who collected much of the material upon which this study is based.

Biology. From the specimens at hand, *Dikraneura omani* is seen to be present



FIGS. 87–99. *Dikraneura omani* sp. n. 87, head, pronotum and scutellum, dorsal view; 88, same; 89, male pygofer, posterior view; 90, male pygofer, valve and subgenital plate, left lateral view; 91, aedeagus, left lateral view; 92, aedeagus, posterior view in direction of arrow in fig. 91; 93, female genitalia, ventral view; 94, left subgenital plate, ventral view; 95, connective, anterodorsal view; 96, connective, left lateral view; 97, abdominal apodemes, dorsal view; 98, left style, dorsal view; 99, left style, left lateral view. Scale as in figs. 1–16.

during July throughout its entire range. It has also been taken during May and August in California. Further details of its biology are unknown.

Remarks. *Dikraneura omani* is closely related to *D. carneola* (Stål) but may be distinguished from the latter species by the relatively larger size and shape of the aedeagus, the presence of microspines near the posteroventral region of the lateral surface of the pygofer, as in *D. variata* Hardy, and by the much longer abdominal apodemes. Externally *D. omani* and *D. carneola* are distinguished by the slightly larger size of *D. omani*, its possession of two longitudinal stripes on the vertex and pronotum, its head being narrower rather than wider than the pronotum and its more produced and acutely angled vertex. It may be distinguished from the sympatric species *D. rufula* Gillette, which also possesses approximately similar markings on the vertex and pronotum, by its usually greenish yellow rather than reddish coloration of these markings and by its larger size. The male genitalia of both species are also diagnostic.

Dikraneura shoshone DeLong & Caldwell

(Text-figs. 100–111)

Dikraneura carneola var. *shoshone* DeLong & Caldwell, 1937*a* : 27. **stat. n.**

Length: ♂ 3·54–3·98 mm. (mean 3·74 mm.).

Head with width slightly greater than that of pronotum, vertex moderately produced with apex broadly rounded in dorsal aspect, medial length approximately 1⅔ times length next eyes, narrowly or broadly rounded to face, with latter approximately as long as wide, ocellocular area 1¼ times width of antennal fossa; pronotum with width increasing only slightly posteriorly.

Colour of head cream or pale stramineous, paling laterally on genae, vertex on each side of midline faintly washed with yellow or orange, eyes testaceous. Pronotum pale cream, disc faintly sordid, rarely pinkish, with a patch on each side of midline over anterior half yellowish or pale orange; scutellum pale cream, basal triangles yellow or orange; remainder of thorax dark brown marked laterally with yellow. Legs pale stramineous. Fore wings with basal area subhyaline greenish yellow, sometimes pinkish, usually very pale; apical half hyaline with veins cream, apical cells sometimes faintly smoky brown. Hind wings hyaline, veins colourless or brownish. Abdomen with dorsum dark brown to black, with lateral margin sometimes yellow, venter dark brown to black, with posterior and lateral edge of sternites sometimes whitish or yellow; male pygofer and anal tube dark brown to black, subgenital plates pale cream, valve concolorous with plates or dark brown.

Male apodemes short, each with length approximately equal to width, sometimes absent.

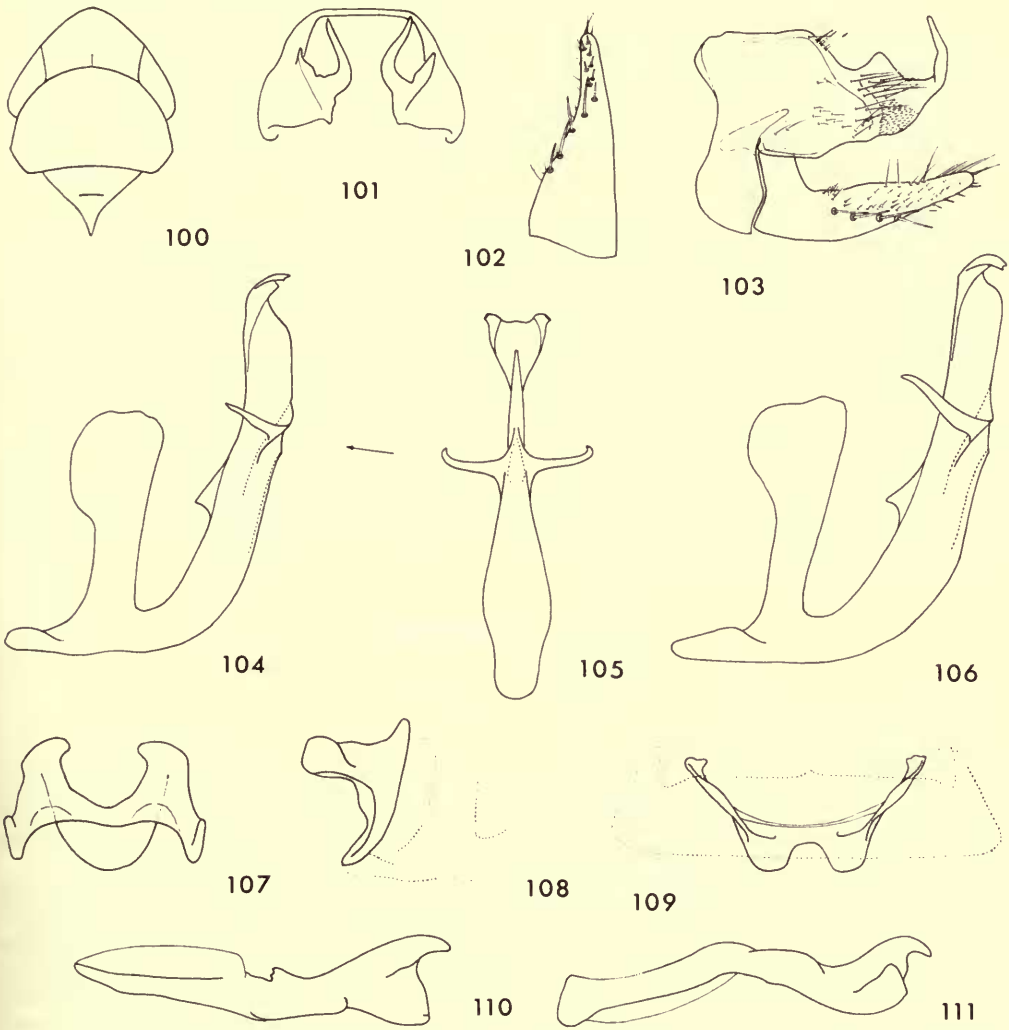
Male genitalia with pygofer as in *D. variata* Hardy but with lateral hair-like setae extending more dorsoposteriorly and microspines restricted to posteroventral area of lateral surface. Aedeagus with preatrium and dorsally directed basal apodeme well developed, the latter expanded apically; shaft directed dorsally, tapering in posterior aspect and terminating in a pair of short posteriorly directed processes, their bases expanded and united into a flattened shield-like plate, a pair of elongate processes, slightly variable in length, posterolaterally immediately distad of midlength, directed laterally and then anterodorsally, a pair of short triangular processes on anterior margin immediately basad of midlength; gonopore on posterior margin between bases of posterolateral processes.

Female unknown.

Distribution. British Columbia (Beirne, 1952*b*), Idaho (DeLong & Caldwell, 1937*a*).

Specimens seen. CANADA: Alta., Banff, 2 ♂, 17.vi.50 (*B. P. Beirne*). UNITED STATES: Mont., Hamilton, 1 ♂, 19.vii.1949 (*R. H. Beamer*); Wyo., Yellowstone Nat. Pk., 1 ♂, 12.vii.35 (*Oman*); Me., Bar Harbor, 1 ♂, no date (*W. Procter*).

New Records: Alberta, Montana, Wyoming, Maine.



FIGS. 100–111. *Dikraneura shoshone* DeLong & Caldwell. 100, head, pronotum and scutellum, dorsal view; 101, male pygofer, posterior view; 102, left subgenital plate, ventral view; 103, male pygofer, valve and subgenital plate, left lateral view; 104, aedeagus (Maine), left lateral view; 105, aedeagus, posterior view in direction of arrow in fig. 104; 106, aedeagus (Banff, Alberta), left lateral view; 107, connective, anterior view; 108, connective, left lateral view; 109, abdominal apodemes, dorsal view; 110, left style, dorsal view; 111, left style, left lateral view. Scale as in figs. 1–16.

The holotype ♂ and 2 ♂ paratypes (UNITED STATES: Ida., Shoshone Basin, 27.vii.30 (*no collector*)) of *D. shoshone*, located in the DeLong Collection, Ohio State University, were studied.

As stated under *D. absenta* DeLong & Caldwell, the type series of *D. feirde* Beirne, located in the Canadian National Collection in Ottawa, is a mixed series, the holotype ♂ and 1 ♂ paratype being *D. absenta* and the remaining 2 ♂ paratypes (CANADA: B. C., Chilcotin, 29.vii.1920 (*E. R. Buckell*) and B. C., Hedley, N. P. Mine, 7.viii.1934 (*A. N. Gartrell*)) being *D. shoshone*.

Biology. Specimens at hand of *D. shoshone* were taken during June in Alberta and July in both Montana and Wyoming. DeLong & Caldwell (1937*a*) record it for July in Idaho and Beirne (1952*b*) records it for July and August in British Columbia.

Remarks. *D. shoshone* is most closely related to *D. variata* Hardy and *D. ossia* Beirne but may be readily distinguished from both these species by the male genitalia. The pygofer of all three species is very similar, although that of *D. shoshone* differs from that of *D. variata* by the setae on the lateral surface extending more dorsoposteriorly and the posterior microspines being more restricted in distribution. It differs from that of *D. ossia* by having the posterior process more elongate and directed more dorsally rather than posteriorly. The aedeagus of *D. shoshone* is perhaps most closely related to that of *D. ossia* in general size and shape of the shaft and the basal expansion of the apical processes into a shield-like plate. They differ however in the length of the apical processes beyond the plate and the fact that in *D. shoshone* the processes on the shaft arise posterolaterally as in *D. variata* rather than laterally as in *D. ossia*.

Dikraneura ossia Beirne

(Text-figs. 112–123)

Dikraneura ossia Beirne, 1952*b* : 251.

Length: ♂ 3·20–3·60 mm. (mean 3·41 mm.). ♀ 3·50–3·82 mm. (mean 3·67 mm.).

Head with width equal to or slightly greater than that of pronotum, vertex moderately produced with apex broadly rounded in dorsal aspect, medial length 1½ times length next eyes, broadly rounded to face with latter approximately as long as wide, ocellocular area equal in width to antennal fossa; pronotum with width increasing slightly posteriorly.

Colour of head pale brownish or sordid cream, paling laterally over genae, vertex sometimes washed with yellow with midline pale cream; eyes testaceous. Pronotum cream with disc sordid, pinkish or pale brownish, anterior margin on each side of midline yellowish; scutellum yellow; remainder of thorax dark brown. Legs pale stramineous. Fore wings with basal area faintly subhyaline greenish yellow; apical half hyaline with veins creamish. Hind wings hyaline with veins dark brown. Female abdomen with dorsum dark brown, venter pale yellowish or cream with anterior half of sternites dark brown; female pygofer pale yellowish or cream with dorsum and apex of ovipositor beyond pygofer dark brown, sternum VII pale yellowish or cream. (Colour of male abdomen not recordable).

Male apodemes short, each with length subequal to width, directed dorsoposteriorly, sometimes absent.

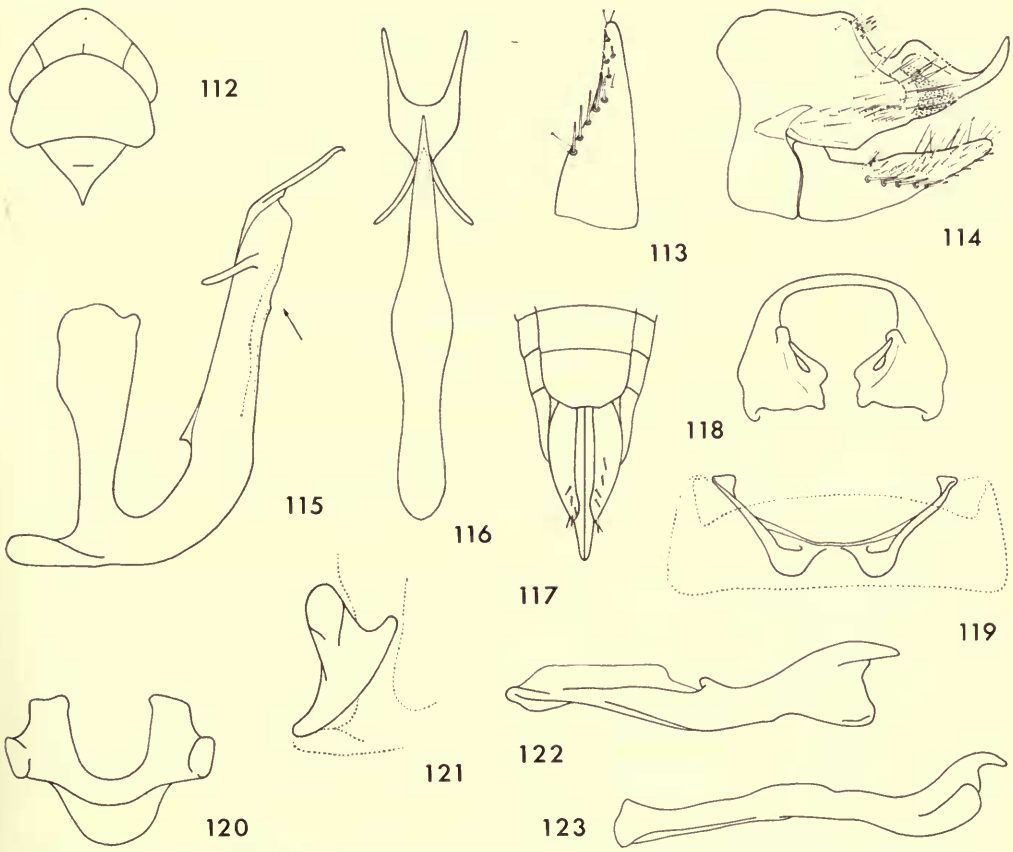
Male genitalia with pygofer as in *D. variata* Hardy but with basal part of process directed more posteriorly. Aedeagus with preatrium and dorsally directed basal apodeme well developed, the latter expanded apically; shaft elongate, straight, directed dorsally, tapering towards

apex in posterior aspect and terminating in a pair of elongate, dorsoposteriorly directed processes, their bases expanded and united into a flattened plate, a pair of processes laterally immediately basad of apex, directed anterolaterally, a pair of short triangular processes on anterior margin immediately basad of midlength; gonopore on posterior margin immediately basad of lateral processes.

Female genitalia with sternum VII as in *D. variata* Hardy.

Distribution. Manitoba (Beirne, 1952*b*).

Specimens seen. UNITED STATES: Alaska, College, 1 ♂, 5 ♀, 22.ix.1943 (*J. C. Chamberlin*); Alaska, Circle Hot Springs, 900′, 1 ♂, 4.viii.1951 (*H. C. Severin*). CANADA: Yukon, Dawson, 1 ♂, 16.vi.1949 (*W. W. Judd*); N. W. T., Norman Wells, 1 ♂, 23.vii.1949 (*W. R. M. Mason*); Man., Swan River, 1 ♂, 2.viii.37 (*R. H. Beamer*).



FIGS. 112–123. *Dikraneura ossia* Beirne. 112, head, pronotum and scutellum, dorsal view; 113, left subgenital plate, ventral view; 114, male pygofer, valve and subgenital plate, left lateral view; 115, aedeagus, left lateral view; 116, aedeagus, posterior view in direction of arrow in fig. 115; 117, female genitalia, ventral view; 118, pygofer, posterior view; 119, abdominal apodemes, dorsal view; 120, connective, anterodorsal view; 121, connective, left lateral view; 122, left style, dorsal view; 123, left style, left lateral view. Scale as in figs. 1–16.

New Records: Alaska, Yukon, North West Territory.

The holotype ♂, allotype ♀ and 2 ♂, 2♀ paratypes (CANADA: Manitoba, Birch River, 3.viii.1937 (*R. H. Beamer*)) and 1 ♂ paratype (CANADA: Manitoba, Mafeking, 3.viii.1937 (*R. H. Beamer*)), all located in the Snow Museum, University of Kansas, were studied together with 2 ♂ paratypes (CANADA: Saskatchewan, Saskatoon, 17.v.1926 (*K. M. King*) and Saskatchewan, Saskatoon, 8.viii.192– (*K. M. King*)) located in the Canadian National Collection in Ottawa. The type series of this species is mixed, the last two paratypes located in Ottawa being the closely related species *D. hungerfordi* Lawson. The former of these two specimens has the body missing from the point.

Biology. *Dikraneura ossia* has been previously recorded only during August in Manitoba (Beirne, 1952*b*). Specimens at hand show it to be present as early as June in the Yukon and as late as September in Alaska.

Remarks. *Dikraneura ossia* is closely related to *D. hungerfordi* Lawson and is further discussed under the latter. The specimens of *D. ossia* from College, Alaska, differ in colour from the majority of specimens, having the disc of the pronotum and the basal half of the fore wings pink with vein *Cu*, to the base of the apical cell, whitish.

Dikraneura hungerfordi Lawson

(Text-figs. 124–137)

Dikraneura hungerfordi Lawson, 1930*e* : 39.

Length: ♂ 3·08–3·40 mm. (mean 3·25 mm.). ♀ 3·30–3·60 mm. (mean 3·45 mm.).

Form and colour as in *D. ossia* Beirne but with vertex slightly more produced in general, head more markedly wider than pronotum and with ventral surface of abdomen, except for lateral and posterior edges of sternites, dark brown to black. (Colour of abdomen not recordable).

Male apodemes as in *D. ossia* Beirne.

Male genitalia with pygofer tapering abruptly posteriorly in lateral aspect and terminating in a narrow finger-like process directed posteromedially and then abruptly dorsolaterally and posteriorly, a small dorsal convexity immediately basad of process; dorsolateral margin with a variable number of spine-like setae near midlength; lateral surface with short hair-like setae over medial area and long spine-like setae posteriorly. Aedeagus as in *D. ossia* Beirne but with shaft arched posteriorly to variable extent and with apical processes relatively shorter, narrower and more divergent.

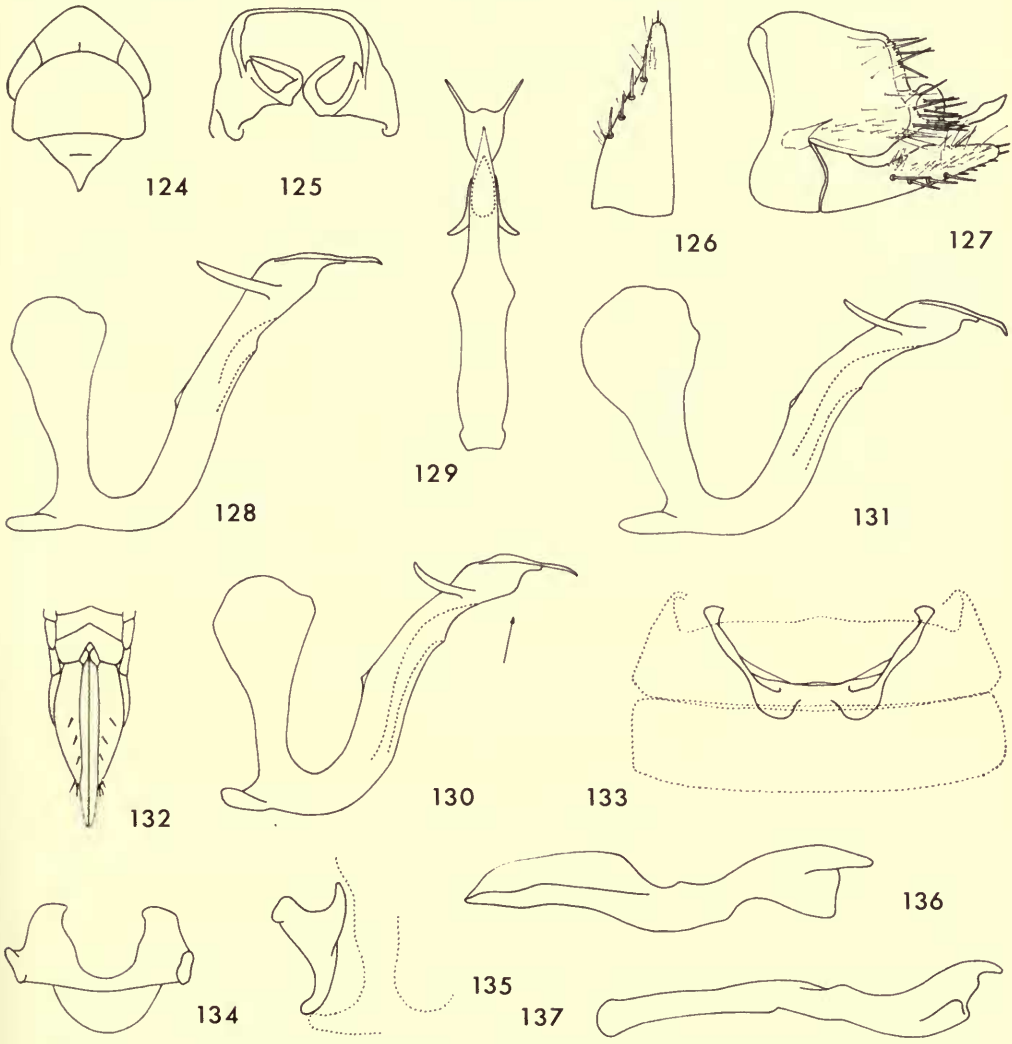
Female genitalia with lateral margins of sternum VII broadly rounded to transverse posterior margin, the latter deeply incised over medial third.

Distribution. Michigan and Ontario (Lawson, 1930*e*).

Specimens seen. CANADA: Alta., Elkwater, 1 ♂, 23.ix.1951 (*A. R. Brooks*); Sask., Saskatoon, 1 ♂, 12.v.1926, 2 ♀, 17.v.1926, 1 ♀, 26.v.1926, 1 ♀, 12.vi.1926, 3 ♀, 8.vi.1929, 1 ♀, 22.vii.1929, 1 ♂, 12.vii.1926 (*K. M. King*). UNITED STATES: Mich., Cheboygan Co., 1 ♂, 21.vii.1941 (*C. Hubbs*); Mich., Cheboygan Co., 1 ♀, 30.vii.47 (*H. B. Hungerford*); Pa., Spring Br., 1 ♂, 1 ♀, 11.v.45 (*no collector*).

New Records: Alberta, Saskatchewan, Pennsylvania.

The holotype ♂, allotype ♀ and 1 ♀ paratype (UNITED STATES: Mich., Douglas Lake, 20.vii.1925 (*H. B. Hungerford*)), 1 ♀ paratype (UNITED STATES: Mich., Douglas Lake, 14.viii.1925 (*H. B. Hungerford*)) and 1 ♀ paratype (CANADA: Ont.,



FIGS. 124–137. *Dikraneura hungerfordi* Lawson. 124, head, pronotum and scutellum, dorsal view; 125, male pygofer, posterior view; 126, left subgenital plate, ventral view; 127, male pygofer, valve and subgenital plate, left lateral view; 128, aedeagus (Elkwater, Alberta), left lateral view; 129, aedeagus, ventral view in direction of arrow in fig. 130; 130, aedeagus (Cheboygan Co., Michigan), left lateral view; 131, same (Spring Br., Pennsylvania); 132, female genitalia, ventral view; 133, abdominal apodemes, dorsal view; 134, connective, anterior view; 135, connective, left lateral view; 136, left style, dorsal view; 137, left style, left lateral view. Scale as in figs. 1–16.

Brockville, 5.viii.1903 (*W. Metcalfe*)), located in the Snow Museum, University of Kansas, were studied. The 2 ♂ paratypes of *D. ossia* Beirne from Saskatoon, Saskatchewan, located in the Canadian National Collection in Ottawa, also belong to the present species.

Biology. *Dikraneura hungerfordi* is active from early to late summer. Lawson (1930*e*) recorded it during July and August in Michigan and August in Ontario while specimens at hand show it to be active as early as May in both Saskatchewan and Pennsylvania and as late as September in Alberta.

Remarks. *Dikraneura hungerfordi* is closely related to *D. ossia* Beirne as can be seen by the shape of the aedeagus which differs mainly by the fact that in *D. hungerfordi* it is arched posteriorly, has the apical processes more slender and directed posterolaterally and the triangular processes on the anterior surface of the shaft minute. This arching of the shaft varies in degree between individuals (cf. Text-figs. 128, 130 and 131) and may assume a near upright position approaching that of *D. ossia*. In addition to the aedeagus, however, the two species show marked differences in both the male pygofer and the female VIIth sternum. Externally, in colour and appearance, the two species are very similar. There is a tendency, however, in *D. hungerfordi* for the vertex to be slightly more produced and for the head to be more markedly wider than the pronotum. *D. ossia* is also slightly longer.

Geographically, *D. ossia* Beirne is more northern in distribution than *D. hungerfordi* although their ranges appear to overlap in the area of Alberta, Saskatchewan and Manitoba. There is no evidence of intermediate forms in the latter area to suggest a possible subspecific relationship although further collecting is undoubtedly required.

Dikraneura abnormis (Walsh)

(Text-figs. 138–150)

Chloroneura abnormis Walsh, 1862*a* : 149.

Length: ♂ 3·76–3·94 mm. (mean 3·88 mm.). ♀ 3·96–4·08 mm. (mean 4·01 mm.).

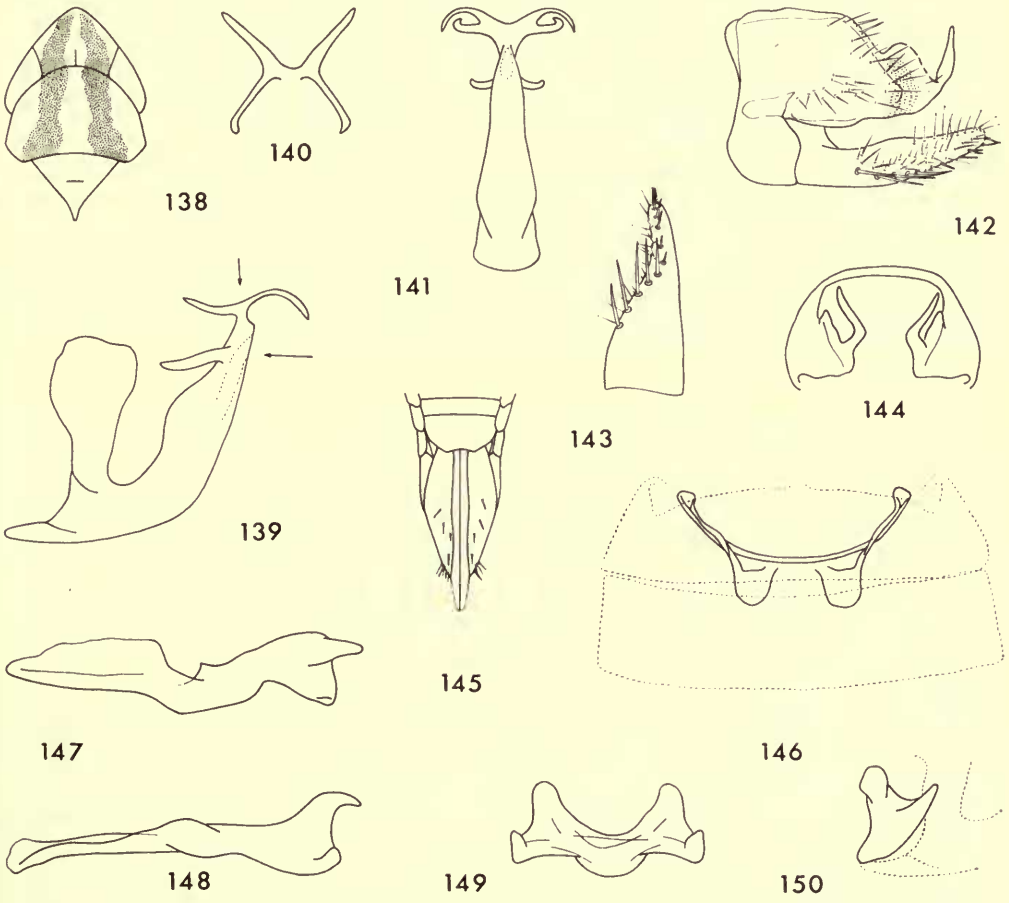
Head with width equal to or slightly greater than that of pronotum, vertex angularly produced with apex acutely rounded in dorsal aspect, medial length nearly twice length next eyes, narrowly rounded to face with latter approximately as long as wide, ocellocular area equal in width to antennal fossa; pronotum with width increasing posteriorly.

Colour of face sordid cream or pale brownish, paling laterally over genae, vertex pale yellowish or whitish cream; eyes testaceous. Pronotum and scutellum pale yellowish or whitish cream, disc of former faintly sordid; with a broad longitudinal vitta on each side of midline, from apex of vertex to posterior margin of pronotum red, sometimes faintly so or yellow; remainder of thorax dark brown marked laterally with yellow. Legs pale stramineous. Fore wings with basal area subhyaline red, sometimes faintly so or yellow, with internal edge of clavus, claval vein, claval suture, *Cu* to base of apical cell and basal half of cell *Cu*, whitish, costal margin pale yellowish; apical half hyaline, faintly smoked dark brown, veins yellowish. Hind wings hyaline, veins dark brown. Abdomen with dorsum dark brown to black, with lateral margin yellow, venter yellow, anterior region of sternites often brown; male pygofer dark brown, paling ventrally to light brown, sometimes uniformly light brown; anal tube light brown, valve and subgenital plates concolorous cream, sometimes smoky; female pygofer pale stramineous with dorsum and apex of ovipositor beyond pygofer dark brown, sternum VII pale yellow.

Male apodemes each with length less than width or subequal, directed dorsoposteriorly to anterior region of fourth segment.

Male genitalia with pygofer as in *D. variata* Hardy. Aedeagus with preatrium only slightly developed, basal apodeme well developed, directed dorsally and expanded apically; shaft directed dorsally, short, exceeding basal apodeme only slightly in length, tapering towards apex and terminating in a pair of laterally directed processes which bifurcate more or less immediately into a pair of divergent arms of subequal length, the entire structure appearing X-shaped in dorsal aspect; a pair of lateral processes just basad of apex, directed anterolaterally; gonopore on posterior margin, level with lateral processes.

Female genitalia with posterior margin of sternum VII broadly rounded, slightly concave medially.



FIGS. 138–150. *Dikraneura abnormis* (Walsh). 138, head, pronotum and scutellum, dorsal view; 139, aedeagus, left lateral view; 140, apical processes of aedeagus, dorsal view in direction of arrow in fig. 139; 141, aedeagus, posterior view in direction of arrow in fig. 139; 142, male pygofer, valve and subgenital plate, left lateral view; 143, left subgenital plate, ventral view; 144, male pygofer, posterior view; 145, female genitalia, ventral view; 146, abdominal apodemes, dorsal view; 147, left style, dorsal view; 148, left style, left lateral view; 149, connective, anterodorsal view; 150, connective, left lateral view. Scale as in figs. 1–16.

Distribution. British Columbia (Downes, 1924*a*), South Dakota (Severin, 1921*c*), Minnesota (Medler, 1943*a*), Wisconsin (Sanders & DeLong, 1917*a*; Ball & DeLong, 1925*a*), Iowa (Osborn & Ball, 1897*a*; Ball & DeLong, 1925*a*), Kansas (Crevecoeur, 1905*a*; Tucker, 1907*a*; Crumb, 1911*a*; Lawson, 1920*a*, 1929*a*; Ball & DeLong, 1925*a*), Missouri (Gibson & Cogan, 1915*a*; Ball & DeLong, 1925*a*), Oklahoma (Davidson & Shackleford, 1929*a*), Texas (Gillette, 1898*a*; Fletcher, 1930*a*), Illinois (Walsh, 1862*a*; Gillette, 1898*a*; Ball & DeLong, 1925*a*; McAtee, 1926*c*; Jones, 1946*a*), Kentucky (Young, 1949), Tennessee (DeLong, 1916*a*), North Carolina (Metcalf, 1915*a*; Brimley, 1938*a*), South Carolina (Lathrop, 1917*a*, 1919*a*), Georgia (Fattig, 1955*a*), Virginia (Ball & DeLong, 1925*a*; Stearns, 1927*a*), D.C. (Gillette, 1898*a*; Ball & DeLong, 1925*a*), Ohio (Osborn, 1900*e*, 1928*b*; Ball & DeLong, 1925*a*; Johnson, 1935*a*), Pennsylvania (Wirtner, 1904*a*; Ball & DeLong, 1925*a*), New York (Ball & DeLong, 1925*a*), Connecticut (DeLong, 1923*a*; Ball & DeLong, 1925*a*), Quebec (Moore, 1944*a*, 1950*a*), Bermuda (Hartzell, 1954*a*).

Specimens seen. UNITED STATES: Kans., La Cygne, 1 ♂, 5 ♀, 12.x.1948, 3 ♂, 1 ♀, 10.x.1948 (*R. H. Beamer*); Ill., Marshall, 2 ♂, 27.ix.1934 (*Frison & Ross*); Ill., Rocky Branch, Dolson, 2 ♂, 6 ♀, 18.vii.1934 (*DeLong & Ross*); Pa., Chambersburg, 1 ♀, 10.ix.20 (*T. L. Guyton*); Md., Plummers Id., 3 ♂, 2 ♀, 8.vi.13, 1 ♂, 17.vi.13, 1 ♀, 4.vii.14, 1 ♀, 6.iv.1913, 1 ♀, 9.v.13 (*W. L. McAtee*); Md., nr. Plummers Id., 1 ♀, 28.iv.1915, 1 ♀, 24.v.1914 (*W. L. McAtee*).

New Records: Maryland.

Walsh's collection, which was housed in Chicago, was partly destroyed by *Anthrenus* and the remainder by fire (Horn, 1926). In his original description, Walsh makes no reference to the locality of *D. abnormis* although he does, in connection with the other two species described in the same paper, mention Bloomington and Rock Island, Illinois. In view of his long association with the state of Illinois (Howard, 1930; Essig, 1931*a*) it is highly probable that his original type series of *D. abnormis* was also from that state. However, in the absence of suitable topotypic material, a neotype was not designated.

Biology. *Dikraneura abnormis* is active from the spring until the later summer, at least over the southeastern part of its range, having been taken as early as March in North Carolina (Metcalf, 1915*a*; Brimley, 1938*a*) and as late as November in Kansas (Crumb, 1911*a*) and Virginia (Stearns, 1927*a*). It has been recorded from grasses (Wirtner, 1904*a*; Crumb, 1911*a*; Gibson & Cogan, 1915*a*; DeLong, 1916*a*; Lawson, 1920*a*; DeLong, 1923*a*; Fletcher, 1930*a*; Fattig, 1955*a*), weeds (Crevecoeur, 1905*a*; Crumb, 1911*a*; DeLong, 1916*a*), sedge (Crumb, 1911*a*), shrubs (DeLong, 1916*a*), vetch (Fattig, 1955*a*), undergrowth in oak woods (Crumb, 1911*a*), canebrakes (DeLong, 1916*a*) and *Aristida* fields (Fletcher, 1930*a*). Specific host plants are *Parsonia* sp. in pasture (Crumb, 1911*a*), *Carpinus* sp. (Johnson, 1935*a*), *Paspalum vaginatum* Sw. (Hartzell, 1954*a*) and *Stenotaphrum secundatum* (Walt.) Kuntze (Hartzell, 1954*a*). It has been recorded as injuring wheat in Texas (Gillette, 1898*a*), grain in Connecticut (DeLong, 1923*a*) and pasture in Georgia (Fattig, 1955*a*).

Remarks. The variation in the degree of development of the red colouration observed in the specimens at hand appears to be a seasonal phenomenon, those taken in April, May and June as well as September and October having the red colour well marked compared with those taken in July which have the pigment poorly developed.

In his original description of this species, Walsh refers to the vittae on the vertex and pronotum as being " more or less obsolete ", that on the anal vein as being " obscure " and sometimes, together with another parallel to it but nearer to the costa, " obsolete ", while the abdomen is described as " black ". Although this description applies equally to the closely related species *D. etiolata* sp. n. as well as the July forms of the present species, the latter is interpreted as *D. abnormis* in view of its occurence in Illinois, *D. etiolata* being more easterly in distribution. The description of *D. abnormis* given by other workers (DeLong, 1916*a*, 1923*a*; Lawson, 1920*a*; McAtee, 1924*a*; Ball & DeLong, 1925*a*; Osborn, 1928*b*; Johnson, 1935*a*), in which emphasis is placed on the possession of distinct vittae, further suggests that the present species is the true *abnormis*. DeLong & Caldwell (1937*a*) however, in the only previous illustration of the male genitalia of " *D. abnormis* ", figure those of the following species, *D. etiolata*, although they make no mention of colour.

Dikraneura abnormis is undoubtedly very closely related to *D. etiolata* sp. n. from which it differs by the more robust aedeagus with its X-shaped apical processes, a more produced and acutely angled vertex and the more intensely developed red colouration of the dorsal vittae and fore wings.

Dikraneura etiolata sp. n.

(Text-figs. 151–163)

Length: ♂ 3·60–3·86 mm. (mean 3·78 mm.). ♀ 3·88–3·96 mm. (mean 3·92 mm.).

Head with width equal to or slightly greater than that of pronotum, vertex angularly produced, sometimes more so in female, with apex broadly rounded in dorsal aspect, medial length approximately 1½ times length next eyes, narrowly rounded to face with latter approximately as long as wide, ocellocular area equal in width to antennal fossa; pronotum with lateral margins more or less parallel.

Colour of head cream, paling laterally over genae and posterior half of vertex, frontoclypeus to near apex, and marginal sutures, washed with yellow, vertex with medial line whitish cream, a diffuse patch on each side yellow; eyes testaceous. Pronotum whitish cream, disc faintly sordid, a broad band on each side of midline yellow often tinged with red over its posterior two-thirds; scutellum whitish cream, basal angles yellow; remainder of thorax dark brown marked laterally with yellow. Legs pale stramineous. Fore wings with basal area subhyaline greenish yellow, often tinged with red, occasionally pale, with internal edge of clavus, claval suture and *Cu* to base of apical cell whitish; apical half hyaline, faintly smoked with dark brown near apex, veins yellowish, paling to whitish apically. Hind wings hyaline, veins whitish. Abdomen with dorsum black, lateral margin yellow, venter dark brown with lateral and posterior margins of sternites yellow, entire sternite predominantly yellow in female; male pygofer and anal tube light brown, valve and subgenital plates concolorous cream; female pygofer pale stramineous with dorsum and ovipositor beyond pygofer dark brown, sternum VII pale stramineous.

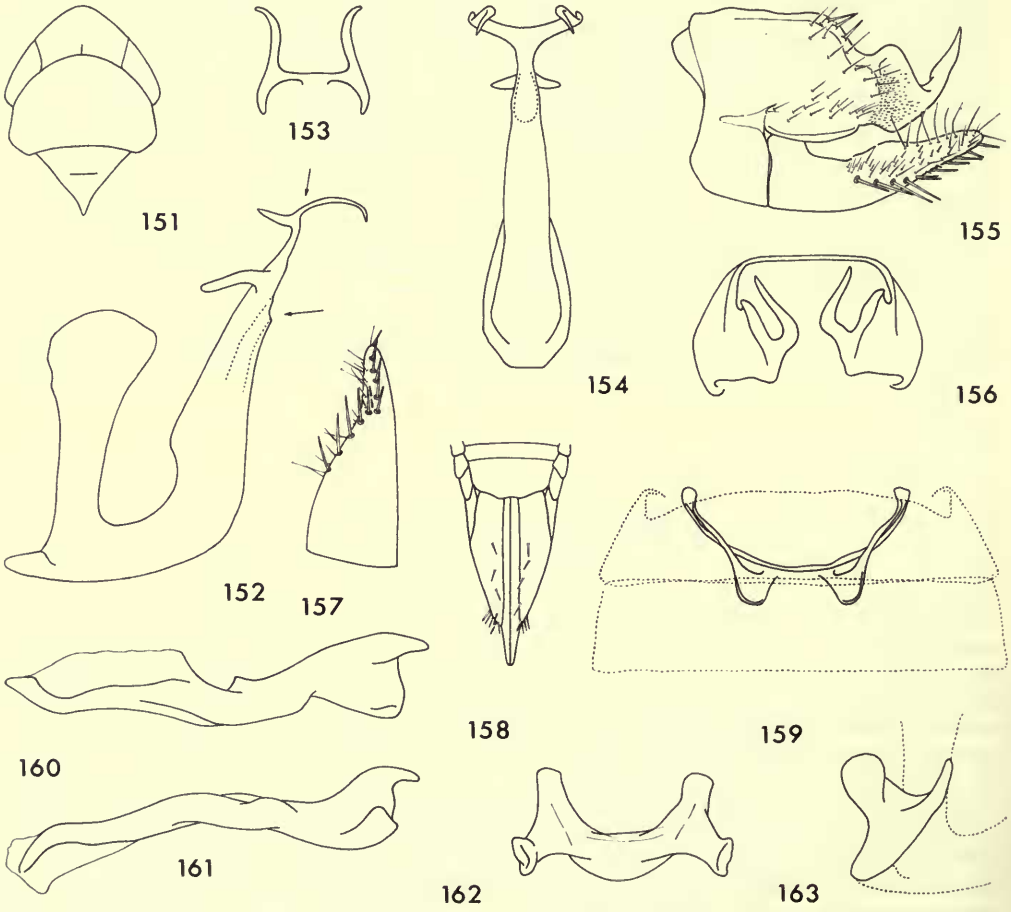
Male apodemes as in *D. abnormis* (Walsh).

Male genitalia as in *D. abnormis* (Walsh) but relatively larger, with aedeagus more elongate, apical processes H-shaped in dorsal aspect and with posterior branches approximately twice length of anterior ones and with lateral processes distad of gonopore.

Female genitalia with sternum VII as in *D. abnormis* (Walsh).

Holotype ♂. UNITED STATES: Mich., Lake Gogebic, 18.viii.37 (*R. H. Beamer*), in Snow Museum, University of Kansas.

Allotype ♀. UNITED STATES: Pa., Port Matilda, 24.viii.18 (*J. G. Sanders*), in DeLong Collection, Ohio State University.



FIGS. 151–163. *Dikraneura etiolata* sp. n. 151, head, pronotum and scutellum, dorsal view; 152, aedeagus, left lateral view; 153, apical processes of aedeagus, dorsal view in direction of arrow in fig. 152; 154, aedeagus, posterior view in direction of arrow in fig. 152; 155, male pygofer, valve and subgenital plate, left lateral view; 156, male pygofer, posterior view; 157, left subgenital plate, ventral view; 158, female genitalia, ventral view; 159, abdominal apodemes, dorsal view; 160, left style, dorsal view; 161, left style, left lateral view; 162, connective, anterodorsal view; 163, connective, left lateral view. Scale as in figs. 1–16.

Paratypes. UNITED STATES: 1 ♂, same data as holotype, in Snow Museum, University of Kansas; Mich., Gogebic, 1 ♂, 18.viii.37 (*R. H. Beamer*), in Snow Museum, University of Kansas; 3 ♂, 3 ♀, same data as allotype, in DeLong Collection, Ohio State University.

Remarks. In addition to the male genitalia, *Dikraneura etiolata*, known only from Pennsylvania and Michigan, differs from *D. abnormis* (Walsh) by the shorter and more obtusely angled vertex, the less marked development of the longitudinal red vittae on the vertex and pronotum and the difference in colouration of the ventral surface of the abdomen. The true relationship of these two closely similar forms is not clear at the moment in view of the relatively short series of specimens available. The possibility that they are seasonal forms of the same species is unlikely since although *D. etiolata* has been taken only during the autumn, *D. abnormis* is known throughout the year. In view of the large number of differences and the absence of intermediate forms, they are currently considered as distinct species.

Dikraneura urbana Ball & DeLong

(Text-figs. 164–176)

Dikraneura abnormis var. *urbana* Ball & DeLong, 1925*a* : 329.
Dikraneura urbana Ball & DeLong; DeLong & Caldwell, 1937*a* : 30.

Length: ♂ 3·36–4·00 mm. (mean 3·63 mm.). ♀ 3·32–4·04 mm. (mean 3·72 mm.).

Head with width equal to or slightly narrower than that of pronotum, vertex angularly produced with apex acutely rounded in dorsal aspect, medial length 1¾–2 times length next eyes, narrowly rounded to face with latter equal to or slightly longer than wide, ocellocular area equal in width to antennal fossa; pronotum with width increasing posteriorly.

Colour of head cream with anteclypeus, frontoclypeus to near anterior margin, marginal sutures and disc of vertex on each side of midline washed with yellow, sometimes faintly so, rarely uniformly cream or brownish cream with above listed areas only slightly darker; eyes testaceous. Pronotum cream, disc sordid, pale brownish or pinkish, a broad band on each side of midline diffusely yellow, sometimes contiguous, sometimes pale and indistinct; scutellum yellowish; remainder of thorax with dorsum dark brown, venter pale stramineous or yellowish. Legs pale stramineous. Fore wings with basal area subhyaline greenish yellow, often pale; apical half hyaline, faintly smoked with brown, with veins yellowish, paling to creamish apically. Hind wings hyaline, veins dark brown. Abdomen with dorsum dark brown, lateral edges yellow, venter yellow, rarely brown with posterior edge of sternites yellow; male pygofer dark brown, paling ventrally to light brown or cream, anal tube light or dark brown; valve and subgenital plates concolorous cream; female pygofer pale stramineous with dorsum sometimes washed with dark brown, ovipositor uniformly pale stramineous, sternum VII pale stramineous.

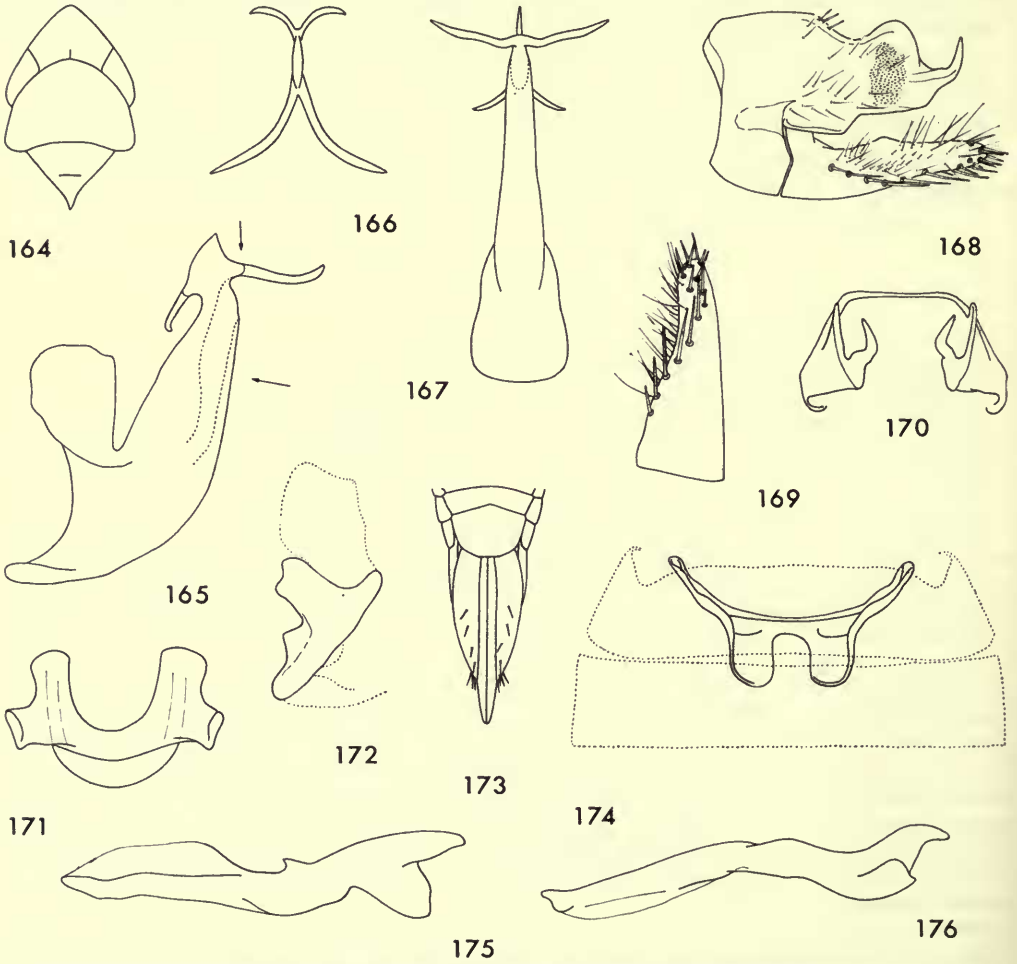
Male apodemes short, each with length subequal to width, extending to anterior region of fourth segment.

Male genitalia with pygofer as in *D. variata* Hardy. Subgenital plates with uniseriate row of spine-like setae along ventrolateral margin, becoming multiseriate apically and extending around apex, the basal half of series only slightly longer than distal half. Aedeagus with preatrium poorly developed, basal apodeme well developed, directed dorsally and expanding apically; shaft directed dorsally, robust, laterally compressed, tapering towards apex and terminating in a thin acute keel-like crest, with two pairs of subapical processes, a posterior pair diverging posterolaterally with their apices turned slightly dorsally and a much shorter and slightly more basad anterior pair diverging ventrolaterally; gonopore on posterior margin immediately basad of posterior subapical processes.

Female genitalia with sternum VII as in *D. variata* Hardy.

Distribution. Iowa (Ball & DeLong, 1925*a*; DeLong & Caldwell, 1937*a*), Minnesota (Medler, 1943*a*), Ohio (Johnson, 1935*a*), New Hampshire (Lowry, 1933*a*).

Specimens seen. CANADA: Ont., Maynooth, 1 ♀, 6.ix.1953 (*B. P. Beirne*); N. B., Fredericton, 1 ♀, 21.viii.1933 (*C. W. B. Maxwell*). UNITED STATES: Me., Orono, 1 ♀, 29.vii.13 (*H. Osborn*); Me., Orono, Maine Agr. Exp. Sta., 1 ♀, 31.vii.1918 (*H. Osborn*); Me., nr. Harpswell, 1 ♂, 12.viii.13 (*H. Osborn*); Me., Mt. Katahdin, 1,000′–1,500′, 1 ♂, 3 ♀, 22.viii.13 (*H. Osborn*); N. Y., Heart Lake, 1 ♂, 30.vii.1946



FIGS. 164–176. *Dikraneura urbana* Ball & DeLong. 164, head, pronotum and scutellum, dorsal view; 165, aedeagus, left lateral view; 166, apical processes of aedeagus, dorsal view in direction of arrow in fig. 165; 167, aedeagus, posterior view in direction of arrow in fig. 165; 168, male pygofer, valve and subgenital plate, left lateral view; 169, left subgenital plate, ventral view; 170, male pygofer, posterior view; 171, connective, anterodorsal view; 172, connective, left lateral view; 173, female genitalia, ventral view; 174, abdominal apodemes, dorsal view; 175, left style, dorsal view; 176, left style, left lateral view. Scale as in figs. 1–16.

(*R. H. Beamer*); N. Y., Fredonia, 1 ♂, 21.vii.46 (*R. H. Beamer*); Mass., Woods Hole, 1 ♀, 15.vii/6.viii.18 (*C. E. Olsen*); Conn., New Haven, 1 ♂, 20.viii.34 (*R. H. Beamer*); Pa., Hartstown B'g., 1 ♂, 5 ♀, 21.vi.21, 1 ♂, 14.ix.19, 1♀, 13.viii.19, 2 ♀, 12.ix.19 (*D. M. DeLong*), 1 ♀, 13.viii.19 (*Mrs. DeLong*), 1 ♀, 22.vi.21 (*T. L. Guyton*); Pa., Kane, 1 ♂, 22.viii.19, 1 ♀, 17.viii.20, 1 ♂, 1 ♀, 19.viii.20 (*D. M. DeLong*); Pa., Rockville, 1 ♂, 4 ♀, 7.vi.18 (*J. G. Sanders*); Pa., Loyalsock, 1 ♂, 22.viii.18 (*J. G. Sanders*); Pa., Greenfield, 1 ♂, 14.vii.22, 1 ♀, 22.viii.20 (*D. M. DeLong*); Pa., Speeceville, 1 ♂, 22.vii.17, 1 ♀, 14.vi.19 (*J. G. Sanders*); Pa., Laurel Run, 1 ♂, 31.v.18 (*J. G. Sanders*); Pa., Northeast, 1 ♂, 4 ♀, 24.vi.19, 2 ♀, 9.viii.19, 1 ♀, 2.vii.19 (*Mrs. DeLong*); Pa., Landisburg, 1 ♂, 3 ♀, 4.vii.18 (*J. G. Sanders*); Pa., Cresson, 2 ♀, 25.vii.18 (*J. N. Knull*); Pa., Waynesburg, 1 ♀, 17.vii.19 (*D. M. DeLong*); Pa., N. Bloomsfield, 1 ♀, 16.vii.20 (*J. G. Sanders*); Pa., Centre Co., Bear Meadows, 1 ♀, 22.viii.18 (*J. G. Sanders*); Pa., Tyrone, 1 ♀, 26.vii.17 (*J. G. Sanders*); Pa., Ohio Pl., 1 ♀, 18.vii.19 (*D. M. DeLong*); N. J., Singae, 1 ♂, 20.viii.16 (*no collector*); Md., Ocean City, 1 ♂, 18.vi.18 (*J. G. Sanders*); Md., Plummers Id., 1 ♂, 8.viii.43, 3 ♂, 2 ♀, 25.viii.43, 1 ♂, 4 ♀, 28.viii.43 (*R. H. Beamer*); D. C., Washington, 1 ♂, 25.x.06 (*J. G. Sanders*); Va., Arlington, 4 ♂, 1.viii.43, 6 ♂, 3 ♀, 12.ix.43 (*R. H. Beamer*); Va., Battle Pt., 1 ♀, 22.vi.18 (*J. G. Sanders*); Va., Cp. Charles, 1 ♀, 31.vii.20 (*D. M. DeLong*); Ohio, Akron, 2 ♂, 2 ♀, no date (*H. Osborn*); Ohio, Wooster, 1 ♂, no date (*H. Osborn*); Kentucky, Cadiz, 1 ♂, 30.vi.1938 (*R. H. Beamer*); Tenn., Clarksville, 1 ♂, 5.vii.1939 (*R. H. Beamer*); N. C., mountains, 1 ♂, 1937–1938 (*Z. P. Metcalf*); N. C., Raleigh, 1 ♀, v.09 (*Z. P. Metcalf*); N .C., Morrow Mtn. State Park, 1 ♂, 22.vii.59 (*F. W. Mead*).

New Records: Ontario, Maine, New Brunswick, New York, Connecticut, Pennsylvania, Massachusetts, New Jersey, Maryland, D.C., Virginia, Kentucky, Tennessee, N. Carolina.

Dikraneura urbana was originally described from 4 ♂, 4 ♀ from Ames, Iowa, of which only 3 ♀ (Exp. Sta. Ames, Ia., Jy. 21.97) located in the U.S.N.M. could be found. No further specimens of the type series could be found in the DeLong Collection. A lectotype was not selected.

Biology. *Dikraneura urbana* is active from spring to late summer. Although the earliest record is for July in New Hampshire (Lowry, 1933*a*) and Ohio (Johnson, 1935*a*), specimens at hand show it to be present as early as May in both Pennsylvania and North Carolina. The latest record is September in New Hampshire (Lowry, 1933*a*) and Ohio (Johnson, 1935*a*) as also for present specimens from Ontario, Pennsylvania and Virginia. Specimens at hand from D.C. however were taken in October. Lowry (1933*a*) records it as fairly common in moist meadows.

Remarks. *Dikraneura urbana*, described originally as a variety of *D. abnormis* (Walsh), may be distinguished externally from the latter species by its more acutely produced vertex and the absence of any marked indication of longitudinal vittae on the head and pronotum. It is similar in external appearance to *D. angustata* Ball & DeLong but is slightly longer and less slender than the latter and lacks the marked yellow longitudinal vittae on the head and pronotum. The male genitalia of all

three species is highly diagnostic. On the basis of the male genitalia, *D. urbana* is most closely related to *D. abnormis* and *D. lacygnensis* sp. n. but may be distinguished from both these species by the shape of the aedeagus.

Dikraneura rubrala DeLong & Caldwell

(Text-figs. 177–193)

Dikraneura (*Notus*) *rubrala* DeLong & Caldwell, 1937*a* : 26.

Length: ♂ 3·32–3·52 mm. (mean 3·42 mm.). ♀ 3·20–3·60 mm. (mean 3·36 mm.).

Head with width equal to or slightly greater than that of pronotum, vertex angularly produced with apex narrowly rounded in dorsal aspect, medial length 1¾ times length next eyes, narrowly rounded to face with latter approximately as long as wide, ocellocular area equal in width to antennal fossa; pronotum with width increasing posteriorly or parallel-sided.

Colour of head pale brownish or sordid cream, paling laterally over genae, anteclypeus yellowish, vertex with a patch on each side of midline over posterior half reddish, midline pale creamish; eyes testaceous. Pronotum with disc reddish, anterior and lateral borders cream with area behind eyes marked with yellow, a patch anteriorly on each side of midline immediately posterior to those on vertex reddish or yellow; scutellum yellow; remainder of thorax dark brown marked laterally with pale yellow. Legs pale stramineous or yellowish cream. Fore wings with basal area subhyaline reddish with a streak along *Cu* whitish; apical half hyaline, faintly smoky brown, with veins reddish, paling to cream apically. Hing wings hyaline with veins dark brown. Abdomen with dorsum dark brown to black, lateral edges of posterior segments sometimes yellow, venter dark brown with anterior segments approaching black, lateral and posterior edges of sternites sometimes yellow; male pygofer, anal tube and valve light or dark brown, subgenital plates cream; female pygofer pale stramineous or creamish with dorsum and apex of ovipositor beyond pygofer brownish, sternum VII creamish.

Male apodemes short, each with length subequal to width, extending to anterior region of fourth segment.

Male genitalia with pygofer as in *D. variata* Hardy but without dorsal convexity at base of process. Aedeagus similar to *D. ossia* Beirne but with apical processes much shorter and wider, with apices mildly bifurcate and basal plate-like expansion wider and oriented at small yet variable angle to horizontal.

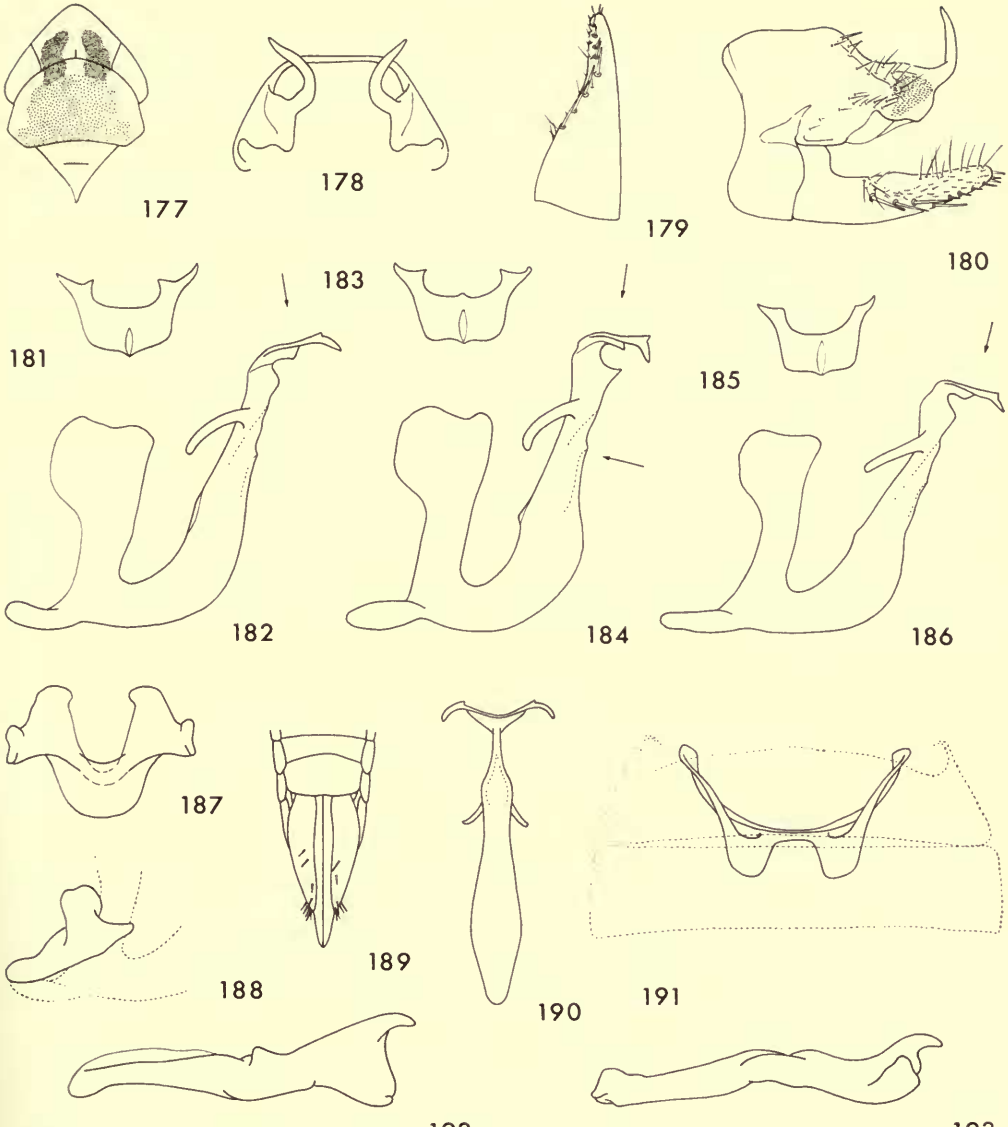
Female genitalia with lateral margins of sternum VII rounded to broadly convex posterior margin.

Distribution. Manitoba (Beirne, 1952*b*), Minnesota, Wisconsin (DeLong & Caldwell, 1937*a*).

Specimens seen. CANADA: Man., Mafeking, 3 ♂, 3.viii.37 (*R. H. Beamer*); Man., Aweme, 1 ♀, 27.v.30 (*R. M. White*); Man., Swan River, 1 ♂, 1 ♀, 2.viii.37 (*C. L. Johnston*); Ont., Maynooth, 1 ♂, 6.ix.1953 (*J. F. McAlpine*). UNITED STATES: Wis., Gillette, 1 ♂, 26.viii.37 (*R. H. Beamer*); Mich., Douglas Lake, 2 ♂, 22.viii.37 (*R. H. Beamer*); Mich., Lake Gogebic, 1 ♀, 18.viii.37 (*R. H. Beamer*); Me., Orono, 1 ♂, 5.viii.13 (*H. Osborn*).

New Records: Ontario, Michigan, Maine.

The holotype ♂, allotype ♀, 2 ♂, 3 ♀ paratypes (UNITED STATES: Minn., Taylor's Falls, 16.viii.16 (*D. M. DeLong*)) and 1 ♂ paratype (UNITED STATES: Wis., Bayfield, 10.ix.16 (*D. M. DeLong*)), all located in the DeLong Collection, Ohio State University, were studied. One paratype, also in the DeLong Collection, with the same data as the holotype, has its abdomen missing.



FIGS. 177–193. *Dikraneura rubrala* DeLong & Caldwell. 177, head, pronotum and scutellum, dorsal view; 178, male pygofer, posterior view; 179, left subgenital plate, ventral view; 180, male pygofer, valve and subgenital plate, left lateral view; 181, apical processes of aedeagus, dorsal view in direction of arrow in fig. 182; 182, aedeagus (Douglas Lake, Michigan), left lateral view; 183, apical processes of aedeagus, dorsal view in direction of arrow in fig. 184; 184, aedeagus (Douglas Lake, Michigan), left lateral view; 185, apical processes of aedeagus, dorsal view in direction of arrow in fig. 186; 186, aedeagus (Gillette, Wisconsin), left lateral view; 187, connective, antero-dorsal view; 188, connective, left lateral view; 189, female genitalia, ventral view; 190, aedeagus, posterior view in direction of arrow in fig. 184; 191, abdominal apodemes, dorsal view; 192, left style, dorsal view; 193, left style, left lateral view. Scale as in figs. 1–16.

Biology. *Dikraneura rubrala* has been previously recorded only during August in both Minnisota and Wisconsin (DeLong & Caldwell, 1937*a*). Specimens at hand indicate this month also for Manitoba, Michigan and Maine as well as Wisconsin. The remaining specimens were taken during May in Manitoba suggesting a longer period of activity than otherwise indicated.

Remarks. *Dikraneura rubrala* resembles *D. rufula* Gillette in general appearance and colour but with the vertex slightly less acutely angled in dorsal aspect. They may be readily distinguished by the male genitalia. It is also similar to *D. abnormis* (Walsh) but shorter, with the vertex less produced and less acute apically and with the disc of the pronotum red and without the distinct longitudinal vittae of *D. abnormis*. The reddish colouration of *D. rubrala* however is sometimes pale or occasionally absent with the patches on the vertex yellow, the disc of the pronotum pale brownish and the basal half of the fore wings pale greenish yellow.

On the basis of the male genitalia and abdominal apodemes, *D. rubrala* is most closely related to *D. ossia* Beirne. The aedeagus of both species is similar in the expansion of the apical processes into a flattened shield-like plate and the possession of lateral processes just basad of the apex. The shape of the apical plate and processes however is diagnostic for each species while the pygofer of *D. rubrala* lacks the dorsal convexity at the base of the posterior process. The colouration of the two species is also distinct.

Dikraneura arizona DeLong & Caldwell

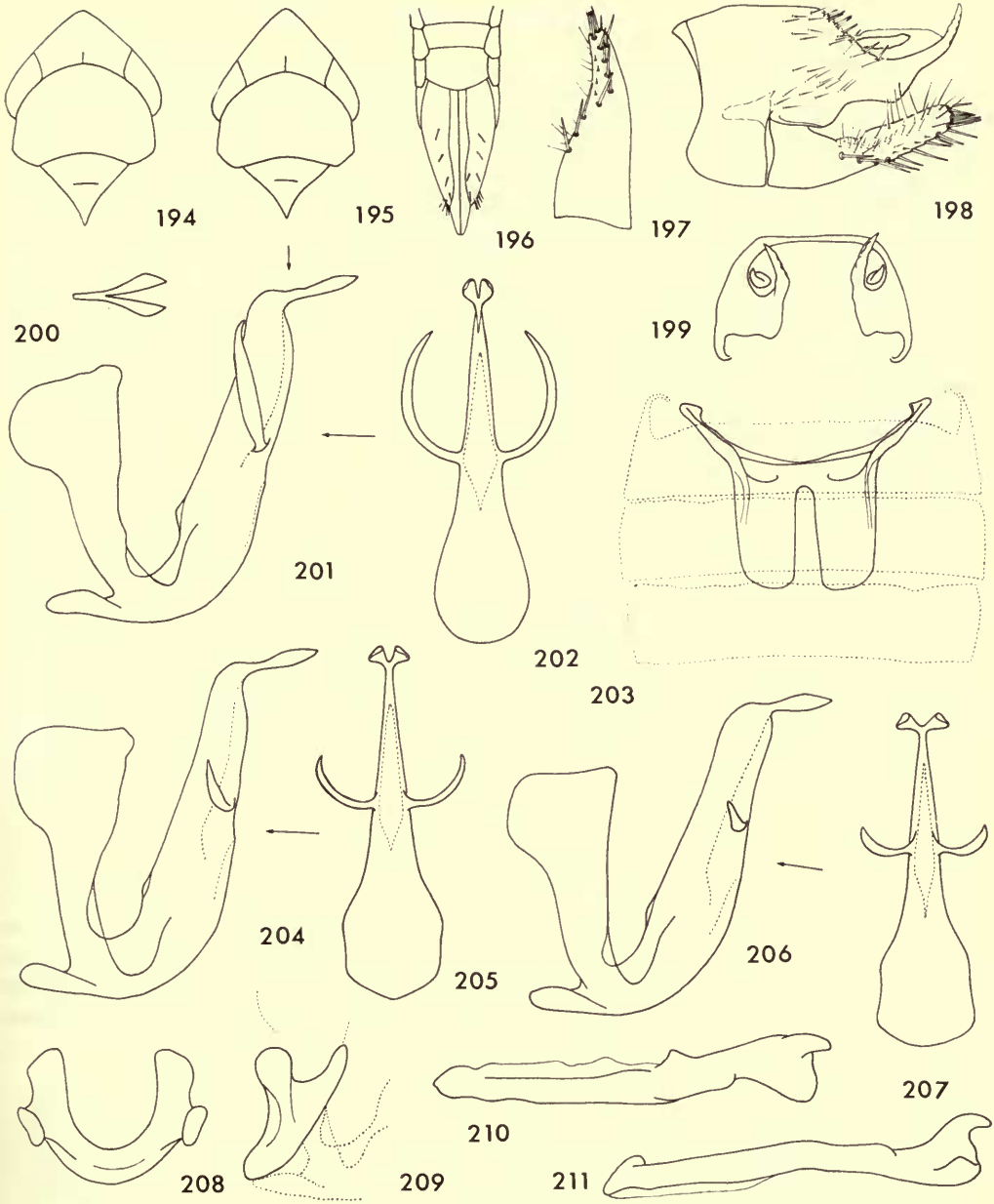
(Text-figs. 194–211)

Dikraneura (*Notus*) *arizona* DeLong & Caldwell, 1937*a* : 26.

Length: ♂ 3·30–3·92 mm. (mean 3·67 mm.). ♀ 3·62–4·28 mm. (mean 3·96 mm.).

Head with width greater than that of pronotum, rarely equal, vertex angularly produced with apex acutely rounded in dorsal aspect, rarely broadly so, sometimes more markedly produced and acutely angled in female, medial length 1¾–2 times length next eyes, narrowly rounded to face with latter as long as or slightly longer than wide, ocellocular area approximately 1⅓ times width of antennal fossa; pronotum with width increasing only slightly posteriorly, often parallel-sided.

Colour of head sordid cream with midline of vertex slightly paler, apical areas of face and vertex washed with dark brown, the two patches tapering towards and meeting at extreme apex, marginal sutures orange or red with marginal area between them, and a small spot above antenna, cream; frontoclypeus washed with red; anteclypeus and lora yellowish; genae cream; eyes testaceous. Pronotum with disc pale brownish, reddish brown or pale sordid pinkish, anterior and lateral edges cream marked with yellow or pale orange; scutellum cream with basal angles and medial area yellow; remainder of thorax dark brown marked laterally with yellow. Legs pale stramineous. Fore wings with basal area subhyaline brownish or greenish yellow, often pale; apical half hyaline smoked with dark brown, veins yellowish paling to cream apically. Hind wings hyaline, veins dark brown. Abdomen with dorsum and venter black, latter sometimes dark brown over posterior half and occasionally over entire venter, sternites with posterior edge rarely yellow or white; male pygofer and anal tube dark brown, occasionally black, valve and subgenital plates concolorous cream, sometimes smoky, valve occasionally brown to dark brown; female pygofer cream with dorsum and apex of ovipositor beyond pygofer dark brown, sternum VII cream.



FIGS. 194–211. *Dikraneura arizona* DeLong & Caldwell. 194, head, pronotum and scutellum, dorsal view (male); 195, same (female); 196, female genitalia, ventral view; 197, left subgenital plate, ventral view; 198, male pygofer, valve and subgenital plate, left lateral aspect; 199, male pygofer, posterior view; 200, apical processes of aedeagus, dorsal view in direction of arrow in fig. 201; 201, aedeagus (Cloudcroft, New Mexico), left lateral view; 202, aedeagus, posterior view in direction of arrow in fig. 201; 203, abdominal apodemes, dorsal view; 204, aedeagus (Mexico City, Mexico), left lateral view; 205, aedeagus, posterior view in direction of arrow in fig. 204; 206, aedeagus (Vera Cruz, Mexico), left lateral view; 207, aedeagus, posterior view in direction of arrow in fig. 206; 208, connective, anterior view; 209, connective, left lateral view; 210, left style, dorsal view; 211, left style, left lateral view. Scale as in figs. 1–16.

Male apodemes elongate, each with length approximately twice width, extending to posterior end of fourth segment.

Male genitalia with pygofer tapering posteriorly in lateral aspect and terminating in a narrow finger-like process directed dorsoposteriorly then abruptly dorsolaterally, an elongate sclerite free within membrane dorsomesad of base of process; dorsolateral margin with a row of spine-like setae along medial sector; lateral surface with setae scattered over medial area. Subgenital plates with uniseriate row of spine-like setae along ventrolateral margin of uniform length, extending around apex. Aedeagus with preatrium short, basal apodeme well developed, directed dorsally and expanded apically; shaft directed dorsally, tapering towards apex and terminating in a pair of flattened, posteriorly directed processes, a pair of posterolateral processes near midlength, directed dorsally and of variable length, a pair of minute widely divergent obtusely angled triangular processes on anterior margin near base; gonopore on posterior margin, elongate along distal half of shaft.

Female genitalia with posterolateral angles of sternum VII broadly rounded, posterior margin broadly convex, sometimes mildly produced medially, rarely slightly concave medially.

Distribution. Colorado, Arizona (DeLong & Caldwell, 1937*a*), Mexico (Ruppel & DeLong, 1953*e*).

Specimens seen. UNITED STATES: S. D., Custer, 13 ♂, 26.viii.1935 (*M. W. Sanderson*); Cal., Guatay, 1 ♂, 3 ♀, 21.vii.41 (*E. L. Todd*); Nev., Austin, 2 ♂, 12.viii.40 (*D. E. Hardy*); Colo., Monument, 2 ♂, 18.viii.36 (*R. H. Beamer*); Colo., Durango, 2 ♂, 2.vii.37 (*R. H. Beamer*), 1 ♀, 2.vii.1937 (*L. D. Tuthill*); Colo., Estes Park, 1 ♂, 18.viii.29 (*D. A. Wilbur*); Colo., Glen Haven, 1 ♂, 1 ♀, 25.vii.1947, 1 ♀, 3.viii.1947 (*P. B. & E. R. Lawson*); Colo., Pinecliffe, 1 ♂, 9.vii.1949 (*R. H. Beamer*); Colo., Mesa Verde, 1 ♀, 3 .vii.1937 (*L. D. Tuthill*); Ariz., Santa Rita Mts., 1 ♂, 10.vii.1950 (*R. H. Beamer*); Ariz., Oak Creek, 1 ♂, 13.xii.39 (*Christenson*); N. M., Cloudcroft, 1 ♂, 14.vii.36, 13 ♂, 27.vi.40 (*R. H. Beamer*), 4 ♂, 8 ♀, 27.vi.1940 (*L. J. Lipovsky*), 6 ♂, 27.vi.40 (*D. E. Hardy*), 4 ♂, 3 ♀, 27.vi.1940 (*L. C. Kuitert*); N. M., Ruidoso, 1 ♂, 26.vi.40 (*R. H. Beamer*), 1 ♀, 26.vi.40 (*L. J. Lipovsky*), 2 ♀, 26.vi.1940 (*L. C. Kuitert*); N. M., Cowles, 2 ♂, 18.vii.36 (*R. H. Beamer*); N. M., Mountain Park, 1 ♂, 2 ♀, 27.vi.40 (*L. J. Lipovsky*); N. M., Shiprock, 1 ♂, 27.vii.38 (*D. J. & J. N. Knull*); N. M., Tajique, 1♂, 25.vi.41 (*L. H. Banker*), 1 ♂, 1 ♀, 25.vi.40 (*R. H. Beamer*), 1 ♀, 25.vi.40 (*D. E. Hardy*). MEXICO: Morelos, 10 km. N. Cuernavaca, 1 ♂, 28.xii.1949 (*J. G. Shaw*); 50 km. E. Mexico City, 1 ♂, 29.xii.1949 (*R. H. Beamer*); Hildago, Jacala, 1 ♂, 2.i.1950 (*J. G. Shaw*); Vera Cruz, 9 miles N.W. Jalapa, 1 ♂, 31.xii.1949 (*J. G. Shaw*), 1 ♂, 31.xii.1949 (*R. H. Beamer*), 16 ♂, 31.xii.1949 (*L. D. Beamer*); Chalpultepec, 1 ♀, no date, (*Koebele*).

New Records: South Dakota, California, Nevada, New Mexico.

The holotype ♂, allotype ♀ and 2 ♂ paratypes (UNITED STATES: Colo., El Paso Co., 19.vi.29 (*R. S. Martin*)), 1 ♂, 4 ♀ paratypes (UNITED STATES: Ariz., Santa Rita Mts., 12.vi.33 (*R. H. Beamer*)), 1 ♀ paratype (UNITED STATES: Ariz., Santa Rita Mts., 17.vii.32 (*R. H. Beamer*)), 1 ♀ paratype (UNITED STATES: Ariz., Chiricahua Mts., 8.vii.32 (*R. H. Beamer*)), 1 ♀ paratype (UNITED STATES: Ariz., Granite Dell, 30.vii.33 (*R. H. Beamer*)) and 1 ♀ paratype (UNITED STATES: Colo., Douglas Co., 27.vi.29 (*R. S. Martin*)), all located in the Snow Museum, University of Kansas, were studied. 1 ♂ paratype (UNITED STATES: Ariz., Santa Rita Mts., 17.vii.32 (*R. H. Beamer*)) and 1 ♀ paratype (UNITED STATES: Ariz., Huachuca Mts., 8.vii.32

(*R. H. Beamer*)), located in the DeLong Collection, Ohio State University, were also studied.

Biology. Records for *Dikraneura arizona* are limited to June and July in Arizona and June in Colorado (DeLong & Caldwell, 1937*a*). Of the specimens at hand, June in New Mexico is again the earliest it has been taken. The latest is December in Arizona and Mexico apart from one specimen taken in the latter locality in January. This species, together with other members of the genus in Mexico, is apparently restricted to the pine regions of the higher altitudes (Ruppel & DeLong, 1953*e*).

Remarks. Apart from slight differences in the direction of curvature of the pygofer processes, the individual variation of the male genitalia of *Dikraneura arizona* is negligible. A marked geographical variation is present, however, in the relative length of the lateral processes of the aedeagus. Throughout the United States, from South Dakota to New Mexico, California and Arizona, their length is constant and as illustrated in Text-figs. 201 and 202. Further south in Mexico there is a marked decrease in the length of these processes, the majority being as illustrated in Text-figs. 204 and 205 with one individual (Text-figs. 206 and 207) showing them still smaller. There is no external difference between the United States and Mexican specimens.

Dikraneura arizona is similar externally to *D. carneola* (Stål) but may be recognized by the generally sordid cream rather than yellowish colour of the head and by the dark brown smoky apical areas of the face and vertex. Although similar in male genitalia to *D. carneola* and related species, *D. arizona* is unique by the aedeagus having dorsally rather than anteriorly directed posterolateral processes and the presence at the base of the pygofer process of a distinct sclerite within the surrounding membrane.

Dikraneura triangulata sp. n.

(Text-figs. 212–223)

Length: ♂ 4·36–4·38 mm. (mean 4·37 mm.).

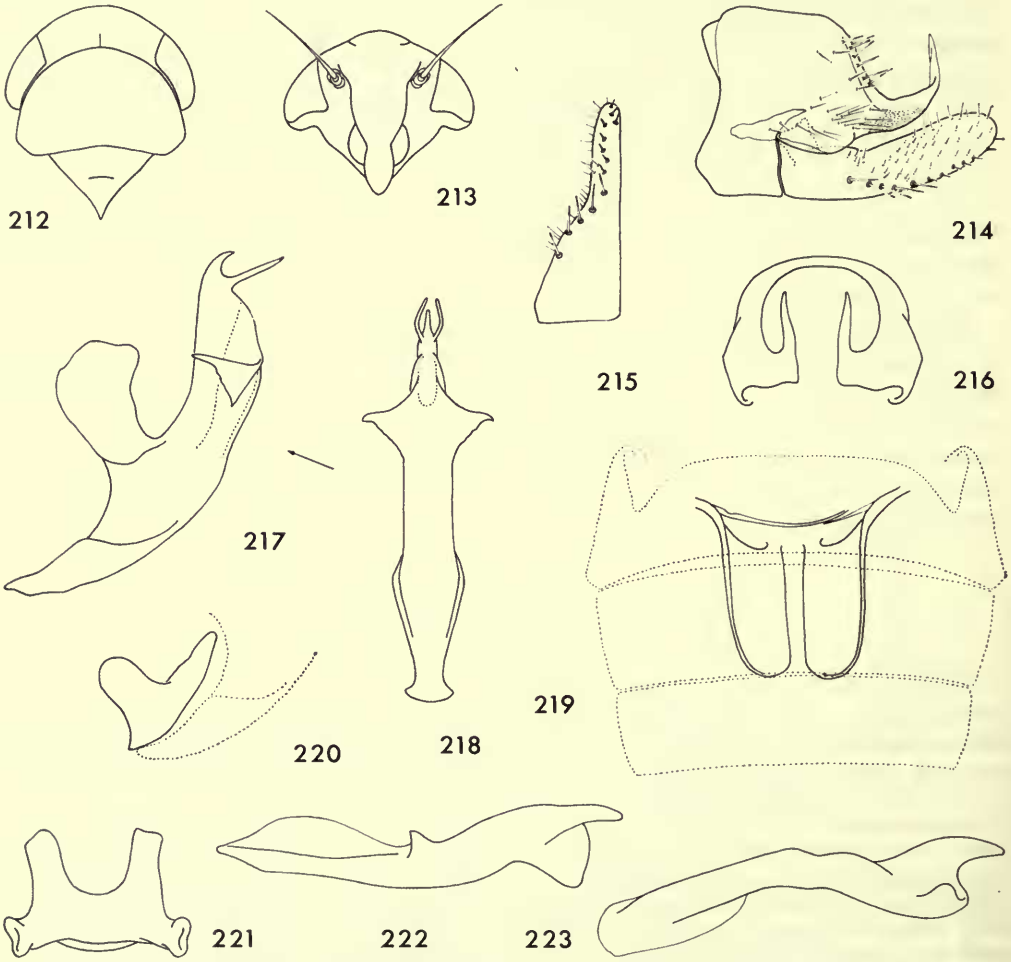
Head with width much greater than that of pronotum, vertex only slightly produced with anterior and posterior margins broadly rounded and approximately parallel, broadly rounded to face with latter wider than long, frontoclypeus slightly tumid, ocellocular area 1½ times width of antennal fossa; pronotum with width increasing posteriorly.

Colour of head light orange-brown, paling laterally over genae to cream, anteclypeus yellowish, facial sutures below antennae dark brown, marginal sutures orange, rim of small aperture approximately central on each gena dark brown; eyes testaceous. Pronotum dirty yellow, disc sordid or pale brownish; scutellum yellow; remainder of thorax dark brown marked laterally with yellow. Legs pale stramineous, sordid, washed at least basally with yellow. Fore wings with basal area subhyaline sordid yellow; apical half hyaline, faintly smoky brownish, veins creamish. Hind wings hyaline pale smoky brown, veins dark brown. Abdomen with dorsum black with lateral edges of posterior segments yellow, venter with anterior segments black, posterior segments dark brown, with lateral and posterior edges of sternites yellow or whitish yellow; male pygofer dark brown, anal tube black, valve dark brown, subgenital plates with basal area smoky yellow, apical area brown.

Male apodemes elongate, each with length approximately twice width, extending to posterior margin of fourth segment.

Male genitalia with pygofer as in *D. latacephala* Beamer but with posterior processes straight and directed dorsally and with a group of microspines posterior to lateral setae and immediately basad of process. Subgenital plates much thicker laterally than usual. Aedeagus with preatrium and dorsally directed basal apodeme well developed; shaft curving dorsally from preatrium, robust, tapering towards apex and terminating in a laterally compressed, acute, posteriorly curved, medial crest; a pair of narrow posteriorly directed elongate processes on posterior margin immediately basad of apex; a pair of broadly triangular, posterolateral processes immediately distad of midlength, directed anterolaterally; gonopore on posterior margin, immediately distad of posterolateral processes.

Female unknown.



FIGS. 212–223. *Dikraneura triangulata* sp. n. 212, head, pronotum and scutellum, dorsal view; 213, face; 214, male pygofer, valve and subgenital plate, left lateral view; 215, left subgenital plate, ventral view; 216, male pygofer, posterior view; 217, aedeagus, left lateral view; 218, aedeagus, posterior view in direction of arrow in fig. 217; 219, abdominal apodemes, dorsal view; 220, connective, left lateral view; 221, connective, anterodorsal view; 222, left style, dorsal view; 223, left style, left lateral view. Scale as in figs. 1–16.

Holotype ♂. MEXICO: D. F., La Guarda, K 40, 26.x.41 (*DeLong, Good, Caldwell & Plummer*), in the U.S. National Museum.

Paratype. 1 ♂, same data as holotype, in the U.S. National Museum.

Biology. *Dikraneura triangulata* is known only from the holotype and paratype taken in Mexico during October.

Remarks. In general appearance, *Dikraneura triangulata* is similar to *D. robusta* Lawson in its more or less unproduced vertex and short wide face with the frontoclypeus slightly tumid and the ocellocular area much wider than the antennal fossa. These characters are unique within the genus and are shown to a lesser degree by only one other species, *D. latacephala* Beamer. *D. triangulata* however is much larger than *D. robusta* and differs greatly in the male genitalia. It is perhaps most closely related to *D. ungulata* Beamer and *D. latacephala* in the ventroposterior origin of the pygofer processes and the absence of a dorsal convexity at their base although is characterized by the processes being straight and directed dorsally rather than recurved. The aedeagus of *D. triangulata* is unique within the genus in its triangular rather than elongate posterior processes and the medial crest at its apex, the latter being found also in only *D. urbana* Ball & DeLong.

Dikraneura latacephala Beamer

(Text-figs. 224–236)

Dikraneura latacephala Beamer, 1943*b* : 57.

Length: ♂ 3·50–3·64 mm. (mean 3·54 mm.). ♀ 3·64–4·40 mm. (mean 3·90 mm.).

Head with width greater than that of pronotum, vertex moderately produced with apex broadly rounded in dorsal aspect, medial length 1½–1¾ times length next eyes, slightly more produced in female, broadly rounded to face with latter slightly wider than long, frontoclypeus slightly tumid, ocellocular area 1⅓ times width of antennal fossa; pronotum with width increasing only slightly posteriorly or parallel-sided.

Colour of head cream or pale brownish, paling laterally over genae; eyes testaceous. Pronotum cream, disc faintly sordid; scutellum pale yellowish cream; remainder of thorax with dorsum dark brown, venter pale stramineous. Legs pale stramineous. Fore wings with basal area whitish subopaque becoming hyaline apically, veins whitish. Hind wings hyaline, veins whitish. Abdomen with dorsum dark brown with lateral edges pale yellow or cream, venter pale yellow; male pygofer and anal tube dark brown, former paling ventrolaterally to cream, valve and subgenital plates concolorous cream; female pygofer cream with dorsum and apex of ovipositor beyond pygofer dark brownish, sternum VII cream.

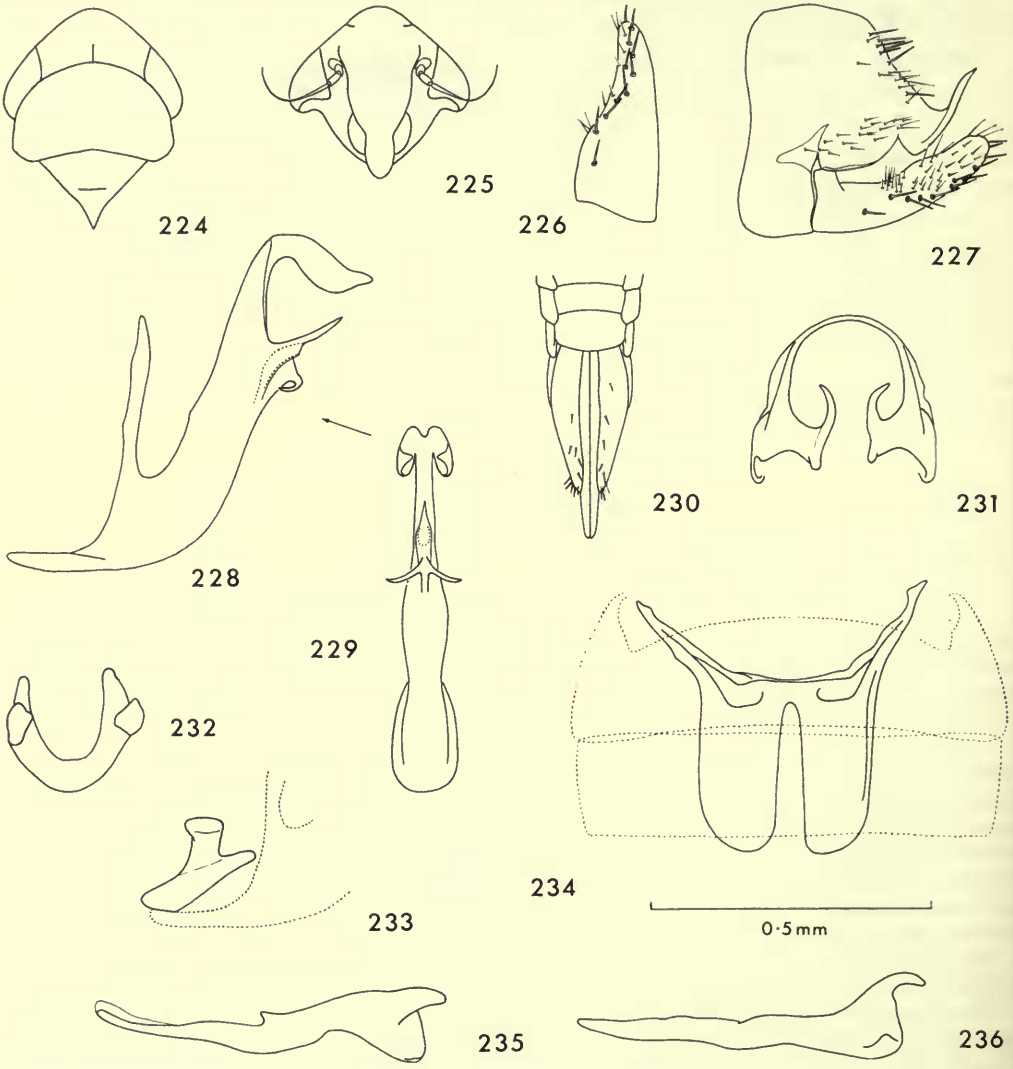
Male apodemes elongate, each with length approximately twice width, extending to posterior end of fourth segment.

Male genitalia[4] with pygofer tapering abruptly posteriorly in lateral aspect and terminating in a narrow finger-like process directed posterodorsally with apex turned dorsolaterally; dorsolateral margin with a row of spine-like setae along vertically inclined sector immediately distad of midlength; lateral surface with hair-like setae over posterior half. Subgenital plates with uniseriate row of spine-like setae along ventrolateral margin of uniform length. Aedeagus with preatrium well developed, basal apodeme directed dorsally; shaft directed dorsally, tapering towards apex and terminating in a pair of large laterally compressed posteriorly directed processes, their apices turned slightly mesad; posterior margin produced approximately one-third

[4] Pygofer, subgenital plates, and connective in available specimens poorly sclerotized and partially membranous, typical of parasitized specimens. The shaft of the aedeagus, the styles and the abdominal apodemes, however, are well sclerotized and normal.

distance from apex as an elongate posterodorsally directed medial spine; a pair of short posterior processes immediately basad of posterior spine, directed laterally and then anteriorly; gonopore on posterior margin at base of medial spine, between latter and posterior processes.

Female genitalia with posterolateral angles of sternum VII broadly rounded, posterior margin broadly convex, sometimes mildly produced medially.



FIGS. 224–236. *Dikraneura latacephala* Beamer. 224, head, pronotum and scutellum, dorsal view; 225, face; 226, left subgenital plate, ventral view; 227, male pygofer, valve and subgenital plates, left lateral view; 228, aedeagus, left lateral view; 229, aedeagus, posterior view in direction of arrow in fig. 228; 230, female genitalia, ventral view; 231, male pygofer, posterior view; 232, connective, anterodorsal view; 233, connective, left lateral view; 234, abdominal apodemes, dorsal view; 235, left style, dorsal view; 236, left style, left lateral view. Scale of fig. 234 as shown, rest as in figs. 1–16.

Distribution. Colorado (Beamer, 1943*b*).

Specimens seen. UNITED STATES: Colo., Pagosa Springs, 5 ♀, 5.vii.1937 (*L. D. Tuthill*); Colo., Durango, 1 ♀, 2.vii.1937 (*L. D. Tuthill*); Colo., Creede, 2 ♀, 6.vii.1937, 1 ♀, 24.vi.1936, 2 ♀, 28.vi.1937 (*L. D. Tuthill*); Colo., Spring Cr. Pass, 4 ♀, 29.vi.1937 (*L. D. Tuthill*).

The holotype ♂, allotype ♀ and 14 ♀ paratypes (UNITED STATES: Colo., Creede, 6.vii.1937 (*R. H. Beamer*)) and 1 ♂, 7 ♀ paratypes (UNITED STATES: Colo., Pagosa Springs, 5.vii.1937 (*R. H. Beamer*)), located in the Snow Museum, University of Kansas, were studied. One paratype (UNITED STATES: Colo., Pagosa Springs, 5.vii.1937 (*R. H. Beamer*)), also located in the Snow Museum, has its abdomen missing.

Biology. Apparently restricted to Colorado, *Dikraneura latacephala* has been recorded during July (Beamer, 1943*b*). Specimens at hand show it to be active in the state during both June and July.

Remarks. *Dikraneura latacephala* is similar to *D. robusta* Lawson and to a lesser extent *D. triangulata* sp. n., in the shape of the head although it is readily distinguished from either of these species by means of the male genitalia. The male pygofer and the abdominal apodemes of *D. latacephala* resemble those of *D. ungulata* Beamer and *D. triangulata* while the aedeagus resembles that of *D. ungulata*, as well as *D. rufula* Gillette and *D. retusa* Beamer, in the elongate spine on the posterior margin.

Dikraneura ungulata Beamer

(Text-figs. 237–242)

Dikraneura ungulata Beamer, 1943*b* : 55.

Length: ♂ 4·20 mm. ♀ 4·30–4·40 mm. (mean 4·35 mm.).

Head with width slightly greater than that of pronotum, vertex angularly produced with medial length twice length next eyes, apex acutely rounded in dorsal aspect; pronotum with width increasing slightly posteriorly.

Colour of head pale yellow, paling laterally over genae to whitish, frontoclypeus and anterior area of vertex faintly smoked brownish or reddish. Pronotum pale yellow, disc whitish or faintly reddish; scutellum pale yellow; remainder of thorax pale yellow, in parts brownish. Legs pale stramineous. Fore wings with basal area colourless opaque or pale reddish; apical half hyaline. Abdomen dark brown to black; female pygofer stramineous with dorsum and apex of ovipositor beyond pygofer dark brown, sternum VII pale stramineous. (Colour of male genital capsule not obtainable).

Male apodemes elongate, length of each twice width, extending to near midlength of fifth segment.

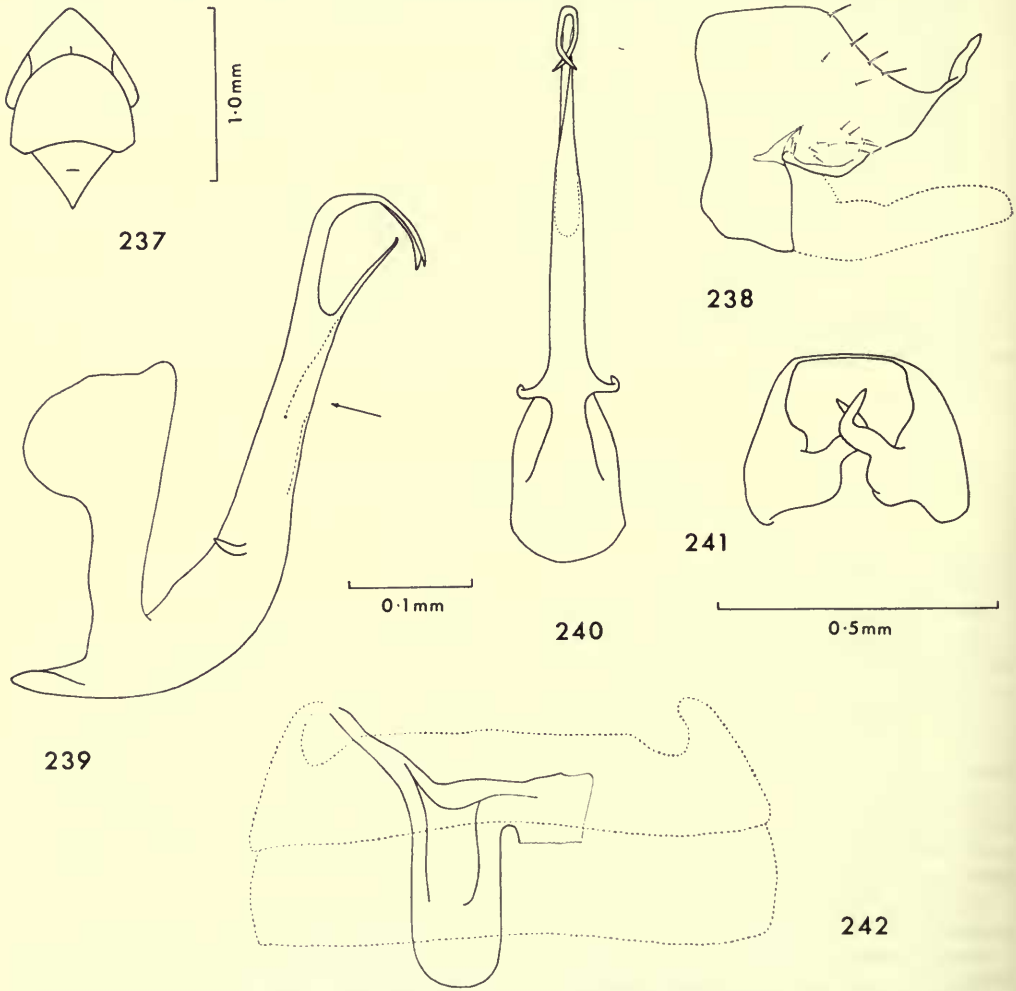
Male genitalia with pygofer and subgenital plates as in *D. latacephala* Beamer but with posterior processes directed dorsomesally and then abruptly dorsolaterally near midlength. Aedeagus with preatrium short; basal apodeme elongate, laterally compressed, directed dorsally and expanding at apex in lateral aspect; shaft elongate, directed dorsally, tapering gradually towards apex, the latter turned posteriorly and terminating in a pair of elongate posteroventrally directed processes, their apices turned mesad and crossed, posterior margin of shaft produced approximately one-fifth distance from apex as an elongate dorsoposteriorly directed spine-like

process terminating just short of apical processes; a pair of very short lateral processes near base of shaft, directed laterally and then anteriorly; gonopore on posterior margin immediately basad of posterior spine.

Female genitalia as in *D. urbana* Ball & DeLong with posterolateral angles of sternum VII broadly rounded, posterior margin transverse.

Distribution. Arizona (Beamer, 1943*b*).

Specimens seen. Holotype ♂, UNITED STATES: Ariz., Santa Rita Mts., 18.viii.35 (*E. I. Beamer*); allotype ♀ and 1 ♀ paratype, UNITED STATES: Ariz., Santa Rita Mts., 18.viii.35 (*R. H. Beamer*), all in the Snow Museum, University of Kansas.



FIGS. 237–242. *Dikraneura ungulata* Beamer. 237, head, pronotum and scutellum, dorsal view; 238, male pygofer and valve, left lateral view; 239, aedeagus, left lateral view; 240, aedeagus, posterior view in direction of arrow in fig. 239; 241, male pygofer, posterior view; 242, abdominal apodemes, dorsal view. Scale as shown with male pygofer and abdominal apodemes to same scale.

Biology. *Dikraneura ungulata* has been recorded only once, during August in Arizona (Beamer, 1943*b*), and its biology is unknown.

Remarks. *Dikraneura ungulata* is closely related to *D. rufula* Gillette in the shape of the aedeagus although it differs greatly in the shape of the pygofer which is more similar to that of *D. latacephala* Beamer. It resembles the former of these species in the general shape of the head but lacks its well developed red colouration.

Dikraneura retusa Beamer

(Text-figs. 243–256)

Dikraneura retusa Beamer, 1943*b* : 55.

Length: ♂ 3·20–3·50 mm. (mean 3·33 mm.). ♀ 3·50 mm.

Head with width greater than that of pronotum, vertex moderately produced with apex broadly rounded in dorsal aspect, medial length 1½ times length next eyes, broadly rounded to face with latter approximately as long as wide, ocellocular area equal in width to antennal fossa; pronotum with width increasing only slightly posteriorly, or parallel-sided.

Colour of head pale brownish or sordid cream, paling laterally on genae, vertex washed with yellow; eyes testaceous. Pronotum yellow marked laterally and often medially at anterior border with cream, disc sordid or pale brownish, often pink; scutellum yellow; remainder of thorax dark brown marked laterally with yellow. Legs pale stramineous. Fore wings with basal area subhyaline greenish yellow, often faintly so, often pink; apical half hyaline, pale smoky brown, veins creamish. Hind wings hyaline with veins dark brown. Abdomen with dorsum dark brown to black, lateral edge yellow, venter dark brown to black, sternites with lateral and posterior edges yellow; male pygofer and anal tube dark brown, valve dark brown, subgenital plates light brown; female pygofer yellowish cream with dorsum and apex of ovipositor beyond pygofer dark brown, sternum VII yellowish cream.

Male apodemes each with length approximately 1½ times width, extending to near posterior margin of fourth segment.

Male genitalia as in *D. rufula* Gillette but with microspines on pygofer rarely present and with aedeagus more elongate, apical processes directed more dorsoposteriorly, lateral processes relatively larger and arising posterolaterally immediately basad of gonopore and anterior processes reduced.

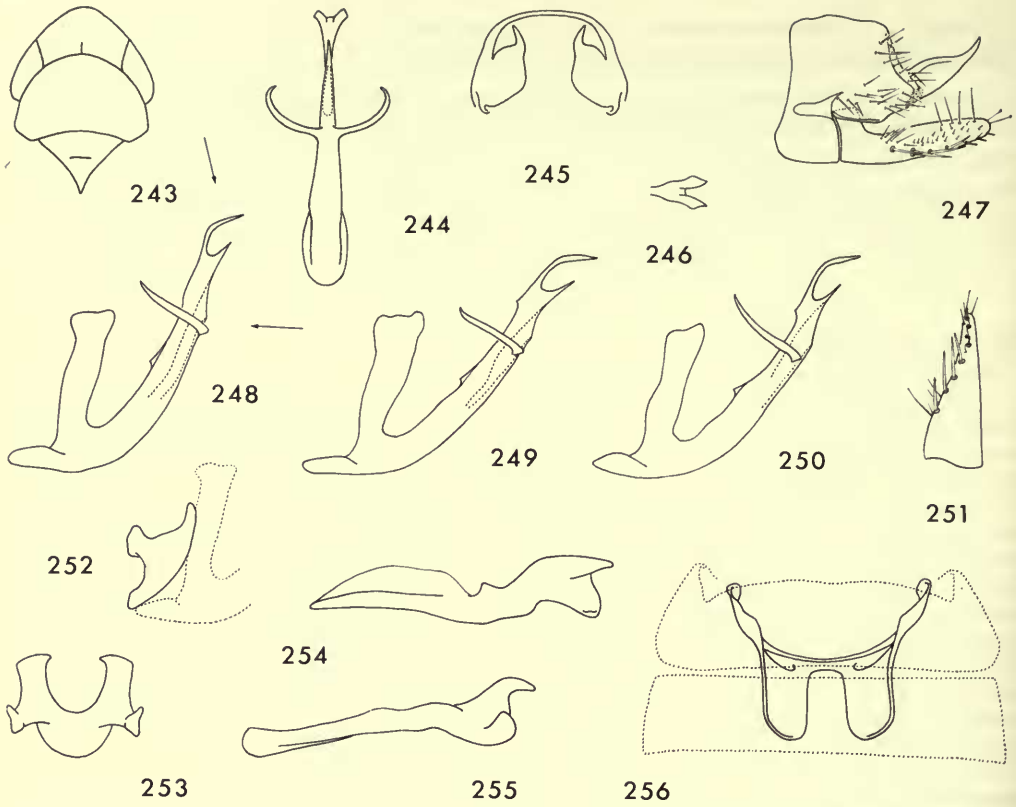
Female genitalia with sternum VII as in *D. omani* sp. n.

Distribution. California (Beamer, 1943*b*).

Specimens seen. UNITED STATES: Cal., Golden Gate, 4 ♂, 17.vii.33 (*R. H. Beamer*); Cal., Monterey, 1 ♂, 22.vii.35 (*R. H. Beamer*); Cal., Santa Rosa, 1 ♂, 16.viii.38 (*R. H. Beamer*); Cal., Berkeley, 1 ♂, ix.1914 (*H. H. P. Severin*).

Holotype ♂, allotype ♀, 1 ♂ paratype (UNITED STATES: Cal., Stinson Beach, 15.viii.38 (*R. H. Beamer*)), 12 ♂ paratypes (UNITED STATES: Cal., Monterey, 22.vii.35 (*R. H. Beamer*)), 1 ♂ paratype (UNITED STATES: Cal., Monterey, 22.vii.35 (*J. Beamer*)), 2 ♂ paratypes (UNITED STATES: Cal., Monterey, 22.vii.35 (*E. I. Beamer*)), 1 ♂ paratype (UNITED STATES: Cal., Monterey, 22.vii.35 (*J. Russell*)), 3 ♂ paratypes (UNITED STATES: Cal., Mt. Tamalpais, 15.viii.38 (*R. H. Beamer*)) and 1 ♂ paratype (UNITED STATES: Cal., Sargent, 22.vii.35 (*R. H. Beamer*)), located in the Snow Museum, University of Kansas, were also studied.

4 ♂ paratypes (UNITED STATES: Cal., Monterey, 10.viii.38 (*R. H. Beamer*)) and 4 ♂ paratypes (UNITED STATES: Cal., Monterey, 22.vii.35 (*R. H. Beamer*)), also located in the Snow Museum, are *D. rufula* Gillette.



FIGS. 243–256. *Dikraneura retusa* Beamer. 243, head, pronotum and scutellum, dorsal view; 244, aedeagus, posterior view in direction of arrow in fig. 248; 245, male pygofer, posterior view; 246, apical processes of aedeagus, dorsal view in direction of arrow in fig. 248; 247, male pygofer, valve and subgenital plate, left lateral view; 248, aedeagus (Monterey, California), left lateral view; 249, same (Golden Gate, California); 250, same (Berkeley, California); 251, left subgenital plate, ventral view; 252, connective, left lateral view; 253, connective, anterior view; 254, left style, dorsal view; 255, left style, left lateral view; 256, abdominal apodemes, dorsal view. Scale as in figs. 1–16.

Biology. *Dikraneura retusa*, found only in the San Francisco-Monterey area of California, has been recorded during July and August (Beamer, 1943*b*). Specimens at hand show it to be present also during September.

Remarks. As far as at present known, *Dikraneura retusa* has a very restricted distribution. Its relationship to the closely related and more widely dispersed species *D. rufula* Gillette is discussed under the latter.

Dikraneura rufula Gillette

(Text-figs. 257–276)

Dicraneura abnormis var. *rufula* Gillette, 1898*a* : 720.
Dikraneura rufula Gillette; Ball & DeLong, 1925*a* : 329.

Length: ♂ 3·32–3·76 mm. (mean 3·54 mm.). ♀ 3·44–3·88 mm. (mean 3·75 mm.).

Head with width equal to or slightly greater than that of pronotum, vertex angularly produced with apex acutely rounded in dorsal aspect, medial length approximately twice length next eyes, narrowly rounded to face with latter as long as or slightly longer than wide, ocello-ocular area equal in width to antennal fossa; pronotum with width increasing only slightly posteriorly.

Colour of head pale brownish or sordid cream, paling over vertex and laterally over genae, a small patch on face above antenna whitish, sometimes indistinct, vertex with a patch on each side of midline over posterior half reddish or orange; eyes testaceous. Pronotum with disc pinkish or reddish, anterior and lateral edges cream marked with yellow or pale orange, a patch at anterior margin on each side of midline immediately posterior to those on vertex reddish, orange, or yellow, sometimes indistinct; scutellum cream or yellow with basal angles and medial area in parts reddish orange; remainder of thorax dark brown marked laterally with cream or yellow. Legs pale stramineous. Fore wings with basal half subhyaline reddish; apical half hyaline, pale smoky brown, veins red. Hind wings hyaline with veins dark brown. Abdomen with dorsum dark brown to black with lateral edges of posterior, and occasionally all, segments yellow, venter dark brown to black, sternites with posterior and lateral edges usually cream or yellow; male pygofer and anal tube dark brown, valve brown, subgenital plates cream or brownish cream; female pygofer stramineous with dorsum and ovipositor beyond pygofer dark brown, sternum VII pale stramineous. Colour pattern rarely devoid of red with disc of pronotum sordid, patches on vertex yellowish and basal area of fore wings greenish yellow.

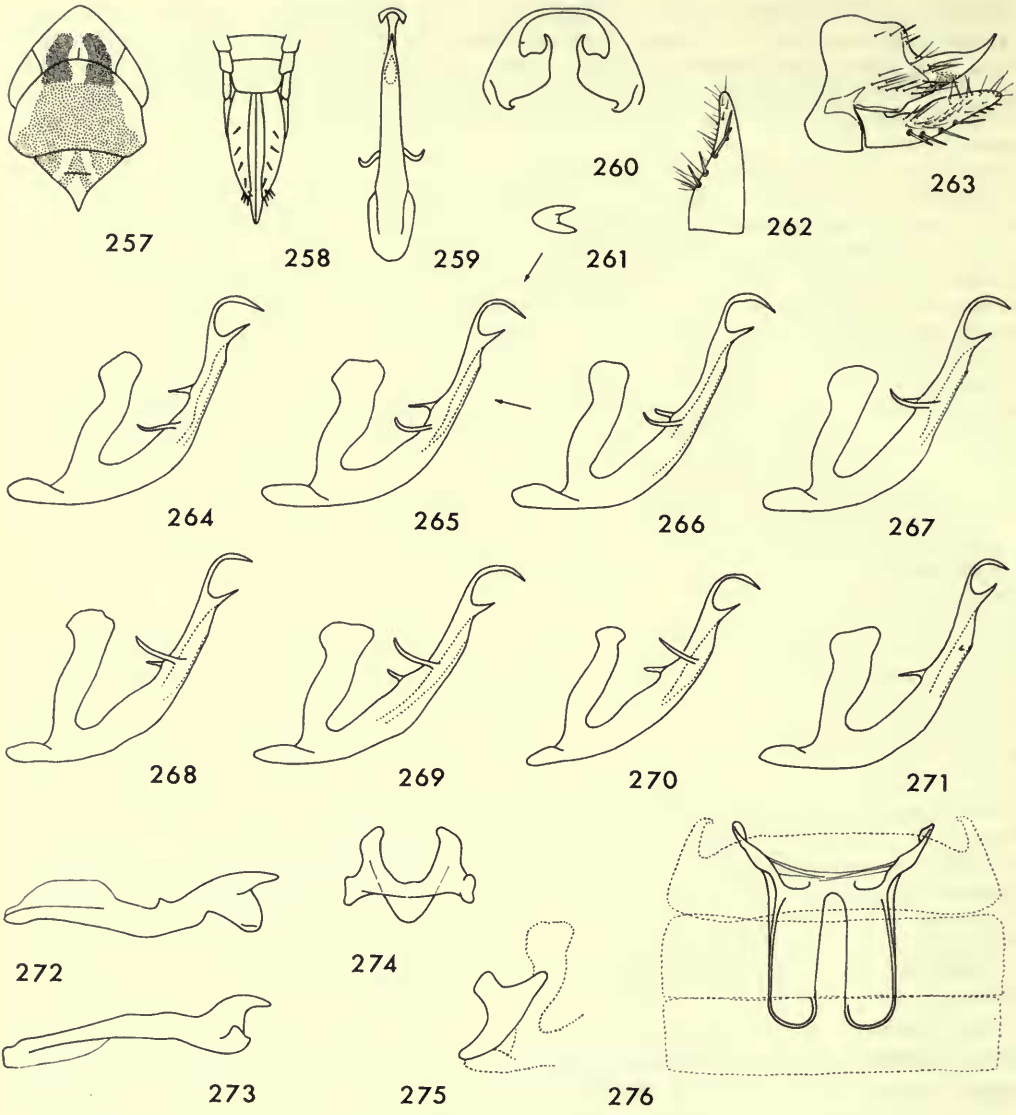
Male apodemes elongate, each with length approximately 3 times width, extending to near midlength of fifth segment.

Male genitalia with pygofer tapering abruptly posteriorly to an elongate dorsoposteriorly directed lobe, the latter terminating in a short peg-like process directed dorsolaterally and posteriorly; lateral surface with numerous setae scattered over posterior half to base of posterior lobe with a small group of microspines ventrolaterally immediately posterior to setae. Aedeagus with preatrium moderately developed; dorsally directed basal apodeme well developed; shaft elongate, directed dorsoposteriorly, tapering towards apex with latter curving posteriorly and terminating in a pair of short robust processes directed ventroposteriorly, an acute medial spine on posterior surface immediately basad of apical processes and directed dorsoposteriorly, the apex in lateral aspect appearing deeply emarginate posteriorly; a pair of elongate lateral processes near midlength of shaft but variable in origin along its length, directed anteriorly and diverging laterally, their apices turned dorsad; a pair of shorter divergent dagger-like processes on anterior margin near midlength directed anteriorly; gonopore on posterior margin immediately basad of medial spine.

Female genitalia with lateral margins of sternum VII broadly rounded to transverse posterior margin.

Distribution. British Columbia (Beirne, 1952*b*), Quebec (Moore, 1950*a*), California (Gillette, 1898*a*; Ball & DeLong, 1925*a*; Lawson, 1930*e*; DeLong & Caldwell, 1937*a*; Beamer, 1943*b*), Utah (Lawson, 1930*e*).

Specimens seen. UNITED STATES: Wash., Du Pont, 3 ♂, 5.vii.35 (*R. H. Beamer*); Ore., Yoncalla, 1 ♂, 12.vii.35 (*R. H. Beamer*); Cal., Giant Forest, 6 ♂, 28.vii.29 (*R. H. Beamer*); Cal., Marin Co., 2 ♂, 3.viii.29 (*R. H. Beamer*); Cal., Stinson Beach, 2 ♂, 15.viii.38 (*R. H. Beamer*); Cal., Tulare Co., 27 ♂, 29.vii.29 (*R. H. Beamer*); Cal., Tulare Co., Wood L., 1 ♂, 3.xi.1947 (*N. W. Frazier*); Cal., Sequoia Nat. Pk., 1 ♂, 1 ♀, 6.40.viii (*R. H. Beamer*), 1 ♂, 6.viii.1940 (*L. J. Lipovsky*), 4 ♂, 3 ♀, 6.viii.1940 (*D. E. Hardy*); Cal., Yosemite Pk., 6 ♂, 10.viii.30 (*no collector*); Cal., Yosemite N. Pk., 1 ♂, 1.viii.1940 (*L. J. Lipovsky*); Cal., Yosemite Valley, 2 ♂, 10.vii.33 (*R. H. Beamer*); Cal., Gen. Grant Pk., 5 ♀, 12.viii.30 (*no collector*); Cal., Ventura, 1 ♂, 20.vii.33 (*R. H. Beamer*); Cal., Lafayette, 1 ♂, 14.vii.33 (*R. H.*



FIGS. 257–276. *Dikraneura rufula* Gillette. 257, head, pronotum and scutellum, dorsal view; 258, female genitalia, ventral view; 259, aedeagus, posterior view in direction of arrow in fig. 265; 260, male pygofer, posterior view; 261, apical processes of aedeagus, dorsal view in direction of arrow in fig. 265; 262, left subgenital plate, ventral view; 263, male pygofer, valve and subgenital plate, left lateral view; 264, aedeagus (Tulare Co., California), left lateral view; 265, same (Tulare Co., California); 266, same (Tulare Co., California); 267, same (Monterey, California); 268, same (Monterey, California); 269, same (Monterey, California); 270, same (Marin Co., California); 271, same (Cuyamaca Lake, California); 272, left style, dorsal view; 273, left style, left lateral view; 274, connective, anterodorsal view; 275, connective, left lateral view; 276, abdominal apodemes, dorsal view. Scale as in figs. 1–16.

Beamer); Cal., Garberville, 1 ♂, 15.vii.35 (*R. H. Beamer*); Cal., Fresno Co., 1 ♀, vii.1919 (*F. E. Blaisdell*); Cal., Leona Heights, 1 ♂, 15.vii.33 (*R. H. Beamer*); Cal., Tuolumne Co., Strawberry, 1 ♂, 22.viii.60 (*E. Jessen*); Cal., Strawberry, 1 ♂, 8.viii.29 (*L. D. Anderson*); Cal., Healdsburg, 2 ♀, 22.x.1941 (*Cook & York*); Cal., Cuyamaca Lake, 2 ♂, 6.vii.29 (*R. H. Beamer*); Cal., Monterey, 8 ♂, 10.viii.38 (*R. H. Beamer*).

New Records: Washington, Oregon.

The ♂ neotype (UNITED STATES: Cal., Dunsmuir, 29.vi.35 (*R. H. Beamer*)), designated by Beamer (1943*b*) and located in the Snow Museum, University of Kansas, was also studied. As stated under *D. retusa* Beamer, eight paratypes of the latter species (UNITED STATES: Cal., Monterey, 4 ♂, 10.viii.38 (*R. H. Beamer*); Cal., Monterey, 4 ♂, 22.vii.35 (*R. H. Beamer*)), also located in the Snow Museum, are in fact *D. rufula*.

Biology. *Dikraneura rufula* has been previously recorded during June in California (Beamer, 1943*b*). Specimens at hand were taken during July in Washington, Oregon and California and as late as November in the latter state.

Remarks. *Dikraneura rufula* may be distinguished externally from the closely related species *D. retusa* Beamer by its more produced and acutely rounded vertex, by the head and pronotum being more or less of equal width and by its distinct reddish colouration. It may be further distinguished from *D. retusa* by the longer male apodemes, the longer and more acute anterior processes of the aedeagus, the smaller size and location of the lateral processes of the aedeagus and to a lesser extent by the shape and degree of curvature of the paired apical processes and by the presence of microspines on the posterior lobe of the pygofer. Some individual variation occurs in the point of origin of the lateral processes of the aedeagus relative to the anterior ones (Text-figs. 264–271), Text-fig. 265 however being the most prevalent form throughout the entire geographical range.

The population at Monterey, California (Text-figs. 267–269) is of particular interest since the variation of the lateral processes approaches in some specimens the condition found in *D. retusa* Beamer. In all other respects they are identical to *D. rufula* although paler in colour with a marked decrease in pigmentation towards the posterior end of the abdomen. The vertex is strongly produced as usual but is sometimes bluntly rounded apically rather than acutely so, while the head itself is in many cases markedly wider than the pronotum, similar to that of *D. retusa*. They are also slightly smaller in size than usual. The specimens from this locality were originally designated as paratypes of *D. retusa*. In addition to the above differences, the abdominal apodemes are, in all specimens except one, rudimentary indicating either parasitization or some other form of abnormality, both possibilities being supported by the reduction in colouration and size. Although rudimentary apodemes and malformed genitalia often occur together as the clear result of parasitization, the precise cause is at other times uncertain. In the present case, the perfect development of the genitalia themselves renders the possibility of parasitization somewhat doubtful, suggesting an alternative cause of abnormality. Two explanations may be offered. These forms are either a further expression of the individual

variation found to be present in Tulare County and the Sequoia and Yosemite National Parks populations, the poorly developed apodemes being purely coincidental, or they may be the result of hybridization between *D. rufula* and *D. retusa* Beamer, the rudimentary apodemes together with the paler colour and smaller size being a symptom of the lower viability of the resultant hybrids. Since *D. rufula* is more widespread, and evidently the more successful of the two species, the predominence of its characters in any hybrid population, as seen in fact in the present forms, would be expected. If they are hybrids we can expect to find *D. retusa* more widespread than at present indicated since single specimens of similar, but less evident, "intermediate" forms have been found at Strawberry and Cuyamaca Lake, California. Whichever of the above explanations is correct, both *D. rufula* and *D. retusa* Beamer are here considered as distinct species. If the "intermediate" forms found at Monterey do indicate a crossing, their relatively poorly developed nature is a symptom of the general imbalance of their genotypes and their obvious inability to produce the correct mating call, as a result of the rudimentary apodemes, and hence compete successfully with the males of either of the two parent species. They are possibly the last visible indications of a relatively recent evolutionary splitting of what were once two subspecies.

Dikraneura rubica DeLong & Caldwell

(Text-figs. 277–289)

Dikraneura (*Notus*) *rubica* DeLong & Caldwell, 1937*a* : 28.

Length: ♂ 3·52–3·80 mm. (mean 3·66 mm.). ♀ 3·76 mm.

Form and colour as in *D. rufula* Gillette but with vertex slightly less produced, the apex less acutely rounded and with patches on posterior region of vertex and anterior region of pronotum pale orange and much less distinct and ventral surface of abdomen pale whitish yellow.

Male apodemes elongate, each with length approximately 3 times width, extending to posterior end of fifth segment.

Male genitalia as in *D. rufula* Gillette but with apical processes of aedeagus more closely apposed, the apical spine on posterior margin absent, the lateral processes arising immediately basad of apex alongside distal half of gonopore and anterior processes less acute and mounted on anterior prolongation of shaft.

Female genitalia with posterolateral angles of sternum VII broadly rounded, posterior margin shallowly concave medially.

Distribution. Arizona (DeLong & Caldwell, 1937*a*).

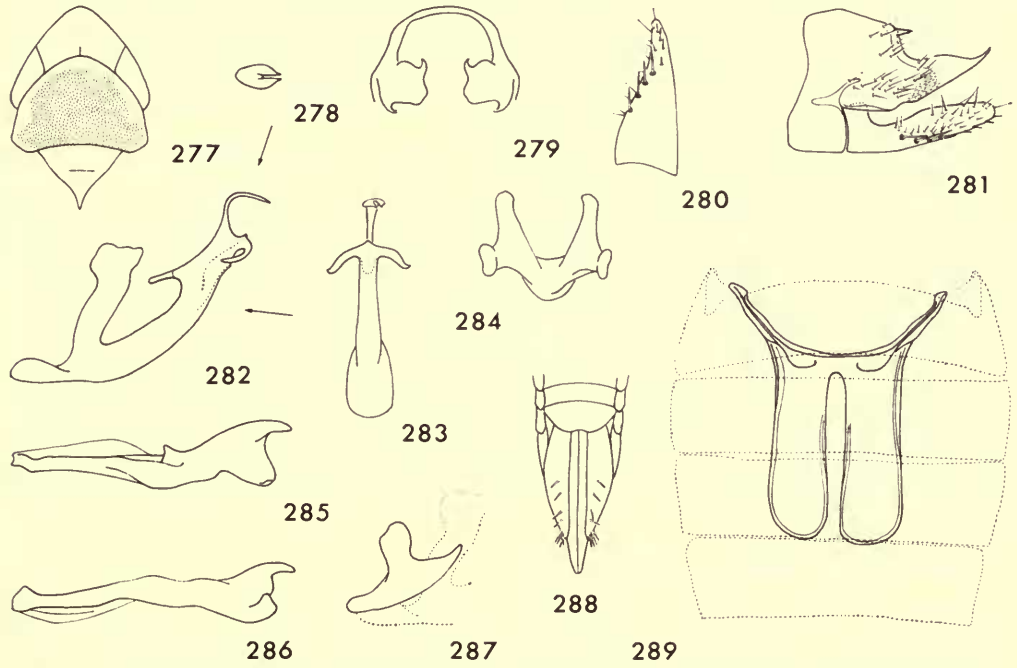
Specimens seen. UNITED STATES: Ariz., White Mts., 1 ♂, 19.vi.1950 (*R. H Beamer*).

The holotype ♂ and allotype ♀ (UNITED STATES: Ariz., Grand Canyon, 11.viii.27 (*R. H. Beamer*)), located in the DeLong Collection, Ohio State University, were also studied. The year of both these specimens differs from that given in the original description. The genitalia of the holotype are also missing from the vial although the specimen in all other respects agrees with the single male specimen studied from the White Mountains, Arizona. The genitalia of the holotype are also well illustrated in the original description and agree with those in the specimen from the White Mountains with the exception that the processes on the anterior surface of the

aedeagal shaft are referred to as a single spine rather than paired processes. Two additional specimens with the holotype and allotype and bearing the same data, are labelled as paratypes. One is a female and the other has its abdomen missing. Neither of these specimens were mentioned in the original description.

Biology. *Dikraneura rubica* has been previously recorded only once, during August in Arizona (DeLong & Caldwell, 1937*a*). Specimens at hand show it to be present in this state also during June.

Remarks. *Dikraneura rubica* is closely related to both *D. retusa* Beamer and *D. rufula* Gillette, resembling the latter species externally but with the markings on the vertex and pronotum much less distinct, the venter of the abdomen whitish yellow rather than dark brown and with the vertex slightly less produced with the apex less acutely rounded. The pygofer of all three species is more or less identical as are also the facies of the aedeagus. In the latter structure, *D. rubica* resembles *D. retusa* in the possession of posterolateral processes and *D. rufula* in the possession of elongate anterior processes. It differs from both these species however by the absence of the posterior medial spine on the aedeagus and the longer male apodemes.



FIGS. 277–289. *Dikraneura rubica* DeLong & Caldwell. 277, head, pronotum and scutellum, dorsal view; 278, apical processes of aedeagus, dorsal view in direction of arrow in fig. 282; 279, male pygofer, posterior view; 280, left subgenital plate, ventral view; 281, male pygofer, valve and subgenital plate, left lateral view; 282, aedeagus, left lateral view; 283, aedeagus, posterior view in direction of arrow in fig. 282; 284, connective, anterodorsal view; 285, left style, dorsal view; 286, left style, left lateral view; 287, connective, left lateral view; 288, female genitalia, ventral view; 289, abdominal apodemes, dorsal view. Scale as in figs. 1–16.

Dikraneura vittata Borland

(Text-figs. 290–305)

Dikraneura vittata Borland, 1955*a* : 158.

Length: ♂ 4·00–4·38 mm. (mean 4·11 mm.). ♀ 4·00–4·24 mm. (mean 4·08 mm.).

Head with width narrower than that of pronotum, vertex angularly produced with apex narrowly or broadly rounded in dorsal aspect, more produced and acutely angled in female, medial length 1½ times length next eyes, broadly rounded to face with latter slightly longer than wide, ocellocular area equal in width to antennal fossa; pronotum with width increasing posteriorly.

Colour of face pale brownish, lora and genae whitish cream, eyes testaceous, vertex and pronotum whitish cream with a longitudinal vitta on each side of midline, from apex of vertex to posterior margin of pronotum, reddish. Scutellum whitish cream with disc marked with yellow, basal angles reddish, sometimes yellow; remainder of thorax with dorsum dark brown, venter pale stramineous. Legs pale stramineous. Fore wings with basal area subhyaline reddish, area between vein *M* and costal margin yellowish, internal edge of clavus, claval vein, claval suture and vein *Cu* to base of apical cell, whitish; apical half hyaline, smoky brown, veins creamish. Hind wings hyaline, veins dark brown. Abdomen with dorsum dark brown to black, lateral edge pale yellow; venter dark brown to black with lateral and posterior edges of sternites pale yellow; male pygofer light brown paling posteroventrally to cream, anal tube cream, valve and subgenital plates concolorous cream; female pygofer pale stramineous with dorsum and apex of ovipositor beyond pygofer dark brownish, sternum VII pale stramineous with medial area of posterior margin light brown.

Male apodemes elongate, each with length approximately 2½ times width, extending to near posterior margin of fourth segment.

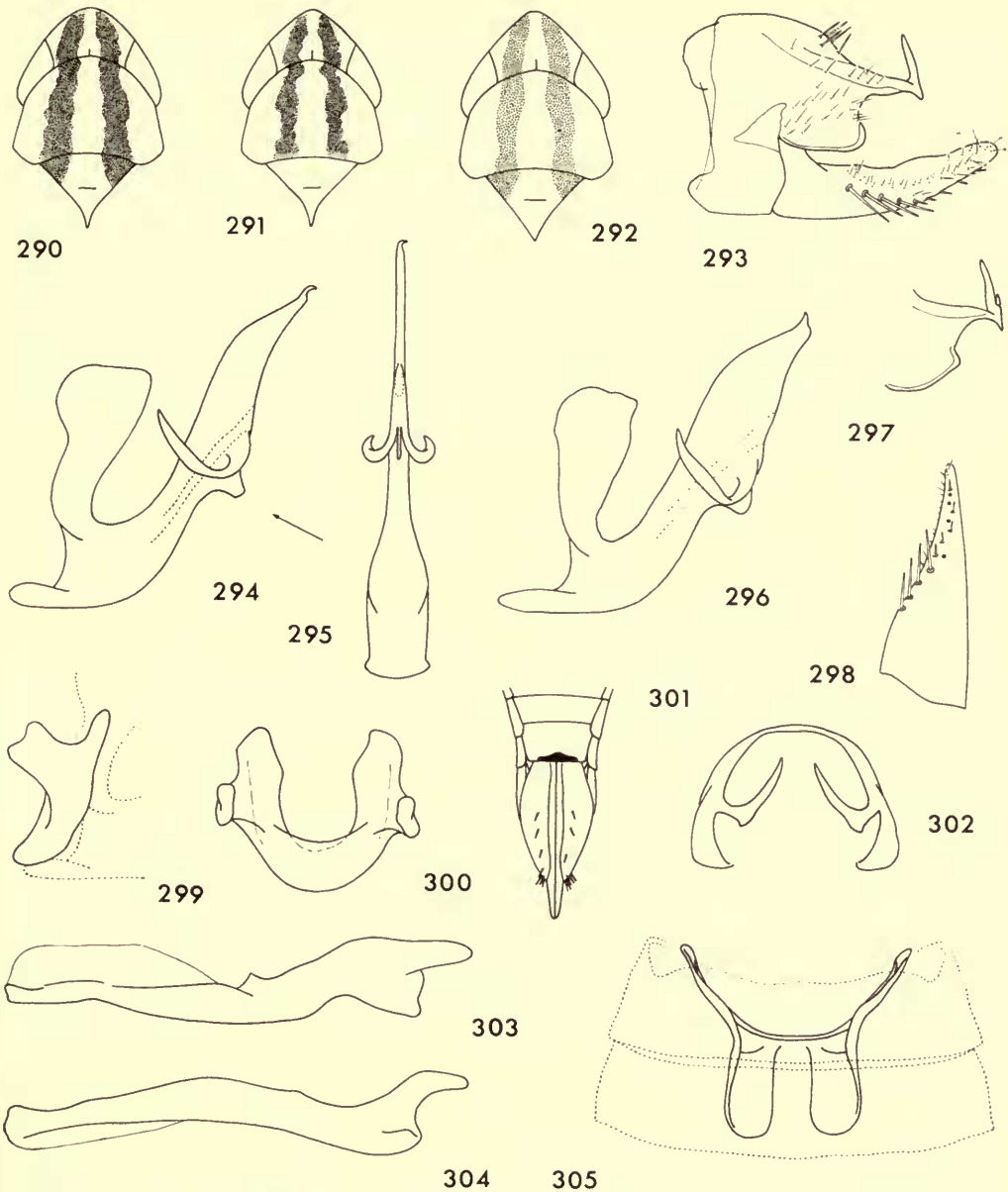
Male genitalia with pygofer tapering abruptly posteriorly in lateral aspect to an elongate process directed posteromesally and sharply recurved dorsomesally approximately one third distance from its base, without teeth or with a single one only on posterior margin immediately distad of elbow; dorsolateral margin with a small group of spine-like setae near midlength; lateral surface with numerous short setae scattered over posterior half. Aedeagus with preatrium short; basal apodeme well developed, directed dorsally, laterally compressed and expanded apically; shaft elongate, directed posterodorsally, laterally compressed, tapering towards apex and terminating in a short variously directed peg-like process, posterior margin produced near midlength as a laterally compressed nose-like projection, a pair of elongate processes posterolaterally immediately distad of projection, curving ventrolaterally and then anterodorsally; gonopore on posterior margin immediately distad of posterolateral processes.

Female genitalia with posterior margin of sternum VII transverse and heavily sclerotized medially.

Distribution. Mexico (Borland, 1955*a*).

Specimens seen. MEXICO: Vera Cruz, 9 miles N.W. Jalapa, 1 ♂, 31.xii.1949, (*R. H. Beamer*); Vera Cruz, Jalapa, 1 ♂, 1 ♀, 1.iv.1963 (*C. G. Martell*).

The holotype ♂ (MEXICO: Vera Cruz, 9 miles N.W. Jalapa, 31.xii.1949 (*L. D. Beamer*)), allotype ♀ (MEXICO: Vera Cruz, 9 miles N.W. Jalapa, 31.xii.1949 (*R. H. Beamer*)), 11 ♂, 1 ♀ paratypes (same data as holotype) and 1 ♂, 1 ♀ paratypes (same data as allotype), located in the Snow Museum, University of Kansas, were also studied. An additional 1 ♂ paratype (MEXICO: Vera Cruz, 9 miles N.W. Jalapa, 31.xii.1949 (*R. H. Beamer*)), also located in the Snow Museum, is a new species, *D. jalapensis*, of which it is designated paratype.



FIGS. 290–305. *Dikraneura vittata* Borland. 290, head, pronotum and scutellum, dorsal view (male); 291, same (male); 292, same (female); 293, male pygofer, valve and subgenital plate, left lateral view; 294, aedeagus (Vera Cruz, Mexico), left lateral view; 295, aedeagus, posterior view in direction of arrow in fig. 294; 296, aedeagus (Vera Cruz, Mexico), left lateral view; 297, posterior process of male pygofer showing basal tooth, left lateral view; 298, left subgenital plate, ventral view; 299, connective, left lateral view; 300, connective, anterior view; 301, female genitalia, ventral view; 302, male pygofer, posterior view; 303, left style, dorsal view; 304, left style, left lateral view; 305, abdominal apodemes, dorsal view. Scale as in figs. 1–16.

Biology. Known only from Mexico, *Dikraneura vittata* has been recorded only during December (Borland, 1955*a*). Of the specimens at hand, some were taken during December and the remainder during April.

Remarks. *Dikraneura vittata* is related to *D. beameri* Borland in the shape of the aedeagus but is unique in its posterior nose-like projection on the shaft. It differs markedly however from *D. beameri* in the more elongate form of the pygofer processes which resemble those of *D. serrata* DeLong & Caldwell. The latter species differs from *D. vittata* however in having 1–3 teeth on each process, the latter being also more anteriorly recurved, and in the shape of the aedeagus. The shape of the female VIIth sternum also indicates the close relationship of *D. vittata* to both these species. In the shape of the pygofer, which resembles in general that of all the previously described species in this paper, and the shape of the aedeagus, which resembles all the species described here after, *D. vittata* may be considered an intermediate form between these two major groups (see discussion).

Dikraneura serrata DeLong & Caldwell

(Text-figs. 306–317)

Dikraneura (*Notus*) *serrata* DeLong & Caldwell, 1937*a* : 24.

Length: ♂ 3·80–4·00 mm. (mean (3·94 mm.). ♀ 4·18 mm.

Form and colour as in *D. vittata* Borland but with vertex slightly more produced and acutely angled, longitudinal vittae on head and pronotum and basal area of fore wings paler or orange and basal angles of scutellum and ventral surface of abdomen pale yellow.

Male apodemes elongate, each with length approximately 2½ times width, extending to anterior region of fifth segment.

Male genitalia with pygofer as in *D. vittata* Borland but with recurved portion of processes directed more anteriorly and with a ventrally directed tooth at elbow and 1–3 smaller teeth along posterior margin. Aedeagus with preatrium short; basal apodeme well developed, directed dorsally; shaft elongate, laterally compressed, directed dorsoposteriorly with apex deeply and broadly emarginate in lateral aspect, the ventral margin of concavity mildly bifurcate apically, the basal half of shaft much narrower in lateral aspect than distal half and with a large rugose lobe on each side at its base; a pair of elongate processes posteriorly near midlength, directed laterally and anterodorsally; gonopore on posterior surface between bases of posterior processes.

Female genitalia with posterior margin of sternum VII transverse with medial region slightly produced and lightly sclerotized.

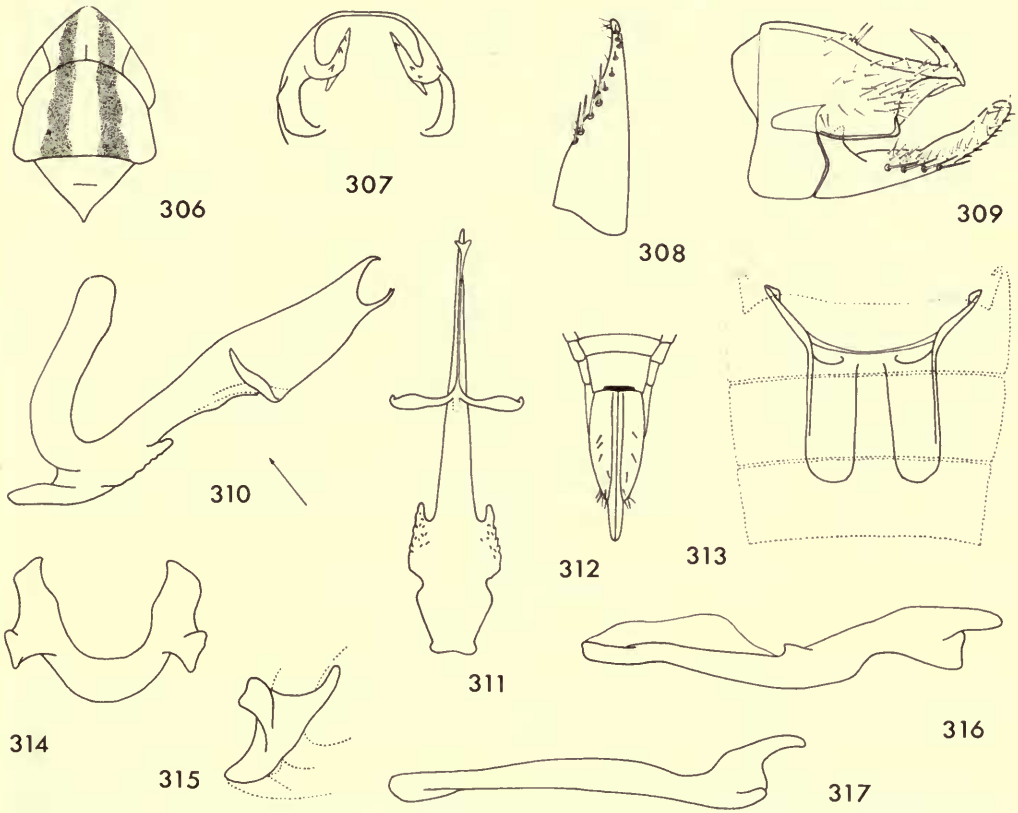
Distribution. Arizona (DeLong & Caldwell, 1937*a*), Mexico (Ruppel & DeLong, 1953*e*).

Specimens seen. UNITED STATES: Ariz., Santa Rita Mts., 2 ♂, 1 ♀, 10.vii.1950 (*R. H. Beamer*).

The holotype ♂, allotype ♀, 6 ♂, 14 ♀ paratypes (UNITED STATES: Ariz., Santa Rita Mts., 12.vi.33 (*R. H. Beamer*)), 2 ♂, 4 ♀ paratypes (UNITED STATES: Ariz., Santa Rita Mts., 17.vii.32 (*R. H. Beamer*)) and 2 paratypes (same data as holotype) with abdomens missing, all located in the Snow Museum, University of Kansas, and 1 ♂ paratype (UNITED STATES: Ariz., Santa Rita Mts., 17.vii.32 (*R. H. Beamer*)) and 3 ♂, 5♀ paratypes (same data as holotype), located in the DeLong Collection, Ohio State University, were also studied.

Biology. The only date previously recorded for *D. serrata* is June in Arizona (DeLong & Caldwell, 1937*a*). Specimens at hand were taken during July in this state. In Mexico, this species, together with other members of the genus, is apparently restricted to the pine regions of the higher altitudes (Ruppel & DeLong, 1953*e*).

Remarks. *Dikraneura serrata* resembles *D. vittata* Borland in general appearance although the red colouration on the vertex, pronotum and fore wings is less vivid than in the latter species. It is related to *D. vittata* also in the elongate form of the pygofer process but may be distinguished by the constant presence of teeth along its posterior margin and its more anteriorly directed recurved portion. The general shape of the aedeagus is similar to that of both *D. beameri* Borland and *D. vittata* but *D. serrata* is unique in having lobes at the base of the shaft and the emargination at its apex.



FIGS. 306–317. *Dikraneura serrata* DeLong & Caldwell. 306, head, pronotum and scutellum, dorsal view; 307, male pygofer, posterior view; 308, left subgenital plate ventral view; 309, male pygofer, valve and subgenital plate, left lateral view; 310, aedeagus, left lateral view; 311, aedeagus, posteroventral view in direction of arrow in fig. 310; 312, female genitalia, ventral view; 313, abdominal apodemes, dorsal view; 314, connective, dorsal view; 315, connective. left lateral view; 316, left style, dorsal view; 317, left style, left lateral view. Scale as in figs. 1–16.

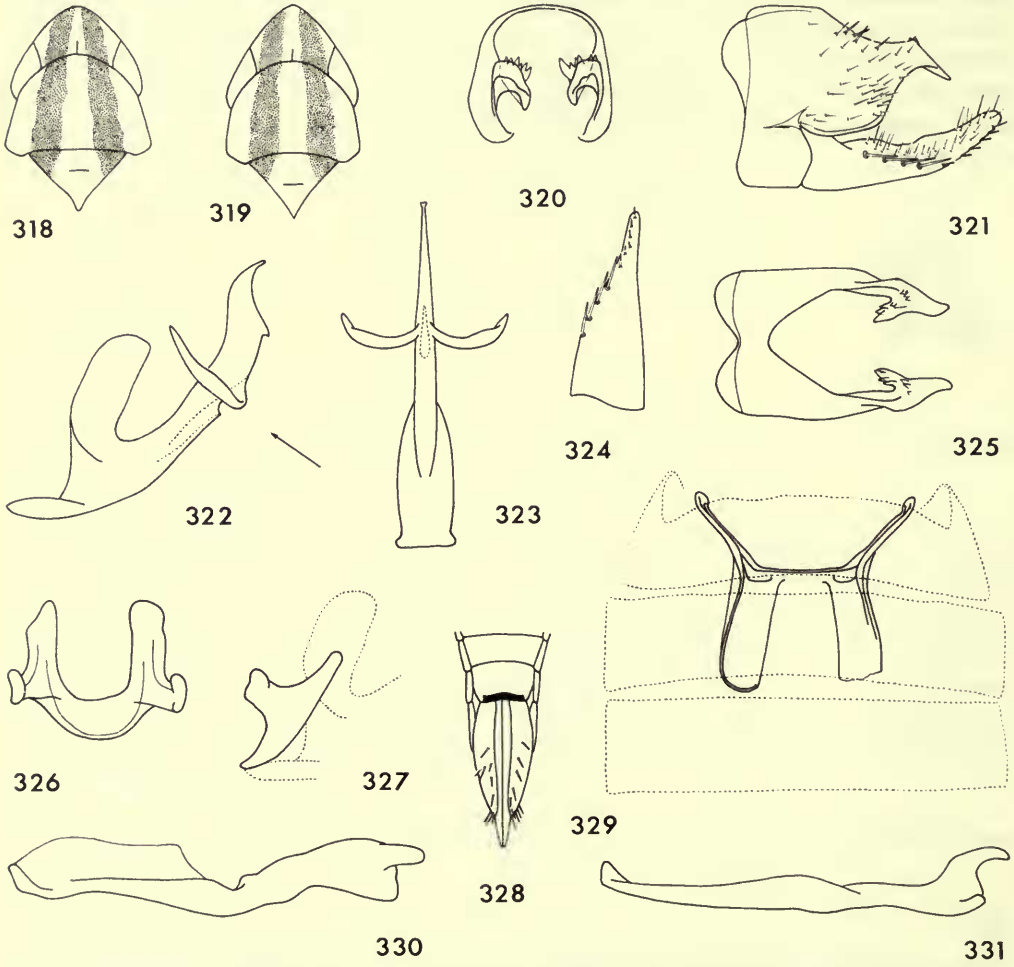
Dikraneura beameri Borland

(Text-figs. 318–331)

Dikraneura beameri Borland, 1955*a* : 159.

Length: ♂ 3·70–4·12 mm. (mean 3·94 mm.). ♀ 3·90–4·12 mm. (mean 4·00 mm.).
Form and colour as in *D. vittata* Borland.

Male apodemes elongate, narrow, each with length approximately 2½ times width, extending to posterior margin of fourth segment.



FIGS. 318–331. *Dikraneura beameri* Borland. 318, head, pronotum and scutellum, dorsal view (male); 319, same (female); 320, male pygofer, posterior view; 321, male pygofer, valve and subgenital plate, left lateral view; 322, aedeagus, left lateral view; 323, aedeagus, posteroventral view in direction of arrow in fig. 322; 324, left subgenital plate, ventral view; 325, male pygofer, dorsal view; 326, connective, anterodorsal view; 327, connective, left lateral view; 328, female genitalia, ventral view; 329, abdominal apodemes, dorsal view; 330, left style, dorsal view; 331, left style, left lateral view. Scale as in figs. 1–16.

Male genitalia with pygofer tapering posteriorly in lateral aspect and terminating dorsoposteriorly in a short robust process recurved anteromesally, its dorsal surface with numerous stout teeth; dorsolateral margin with a group of spine-like setae near midlength; lateral surface with numerous short setae over posterior half. Aedeagus with preatrium short; basal apodeme well developed, directed dorsally; shaft elongate, laterally compressed, directed dorsoposteriorly with apical one-fifth tapered and curving more posteriorly; posterior margin at base of tapered sector acutely produced, sometimes weakly so; a pair of elongate posterior processes immediately distad of midlength directed laterally and anterodorsally; gonopore on posterior margin between bases of posterior processes.

Female genitalia with posterior margin of sternum VII transverse and lightly sclerotized.

Distribution. Mexico (Borland, 1955*a*).

Specimens seen. MEXICO: Vera Cruz, 9 miles N.W. Jalapa, 1 ♂, 31.xii.1949 (*R. H. Beamer*); Vera Cruz, Jalapa, 5 ♂, 2 ♀, 1.iv.1963 (*C. G. Martell*).

The holotype ♂, allotype ♀, 13 ♂, 1 ♀ paratypes (MEXICO: Vera Cruz, 9 miles N.W. Jalapa, 31.xii.1949 (*R. H. Beamer*)) and 14 ♂, 4 ♀ paratypes (MEXICO: Vera Cruz, 9 miles N.W. Jalapa, 31.xii.1949 (*L. D. Beamer*)), together with 5 paratypes (same data as holotype) and 1 paratype (MEXICO: Vera Cruz, 9 miles N.W. Jalapa, 31.xii.1949 (*L. D. Beamer*)) with abdomens missing, all located in the Snow Museum, University of Kansas, were also studied. An additional 1 ♂ paratype (MEXICO: Vera Cruz, 9 miles N.W. Jalapa, 31.xii.1949 (*R. H. Beamer*)) is a new species *D. jalapensis*, of which it is designated holotype, and another 1 ♂ paratype (same data) is *D. ardea* Ruppel & DeLong. Both these specimens are in the Snow Museum.

Biology. Restricted to Mexico, *Dikraneura beameri* was recorded by Borland (1955*a*) in December. Specimens at hand were taken in December and also in April.

Remarks. Externally, *Dikraneura beameri* is indistinguishable from *D. vittata* Borland although each has distinct male genitalia. In the shape of the pygofer, *D. beameri* resembles the species *D. jalapensis* sp. n., *D. dreisbachi* sp. n. and *D. halberda* Ruppel & DeLong. It is also similar to the first two of these species, as well as to *D. vittata* and *D. serrata* DeLong & Caldwell, in the facies of the aedeagus, each however being readily distinguished from the others.

Dikraneura jalapensis sp. n.

(Text-figs. 332–344)

Length: ♂ 3·62–3·82 mm. (mean 3·72 mm.).

Form and colour as in *D. vittata* Borland but paler with anterior half of longitudinal vittae yellowish and with basal area of fore wings sometimes yellow.

Male apodemes elongate, narrow, each with length 3 times width, extending to posterior end of fourth segment.

Male genitalia as in *D. beameri* Borland but with pygofer processes recurved more anteriorly and aedeagus with its distal half in lateral aspect approximately twice width of basal half and tapering abruptly near apex to a pair of short anteriorly directed processes, their apices curving mesad.

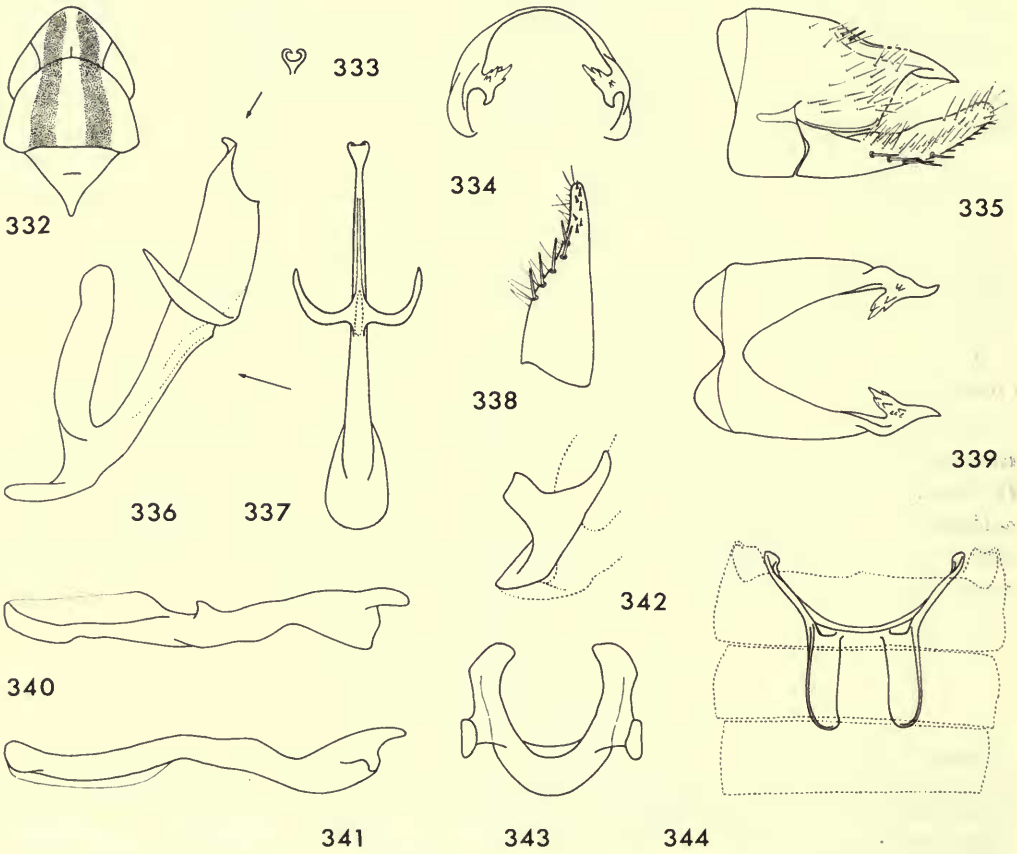
Female unknown.

Holotype ♂. MEXICO: Vera Cruz, 9 miles N.W. Jalapa, 31.xii.1949 (*R. H. Beamer*), in Snow Museum, University of Kansas.

Paratype. 1 ♂, same data as holotype, in Snow Museum.

Biology. Restricted to Mexico, *Dikraneura jalapensis* has been taken only during December.

Remarks. *Dikraneura jalapensis* is closely related to *D. beameri* Borland but with the pygofer processes recurved more anteriorly rather than anterodorsally and with distinct aedeagus. Externally, the two species are indistinguishable except that *D. jalapensis* is paler with the longitudinal vittae on the vertex and pronotum less vivid. The holotype and paratype of the present species were originally designated, without dissection, as paratypes of *D. beameri* and *D. vittata* Borland respectively.



FIGS. 332–344. *Dikraneura jalapensis* sp. n. 332, head, pronotum and scutellum, dorsal view; 333, apical processes of aedeagus, dorsal view in direction of arrow in fig. 336; 334, male pygofer, posterior view; 335, male pygofer, valve and subgenital plate, left lateral view; 336, aedeagus, left lateral view; 337, aedeagus, posterior view in direction of arrow in fig. 336; 338, left subgenital plate, ventral view; 339, male pygofer, dorsal view; 340, left style, dorsal view; 341, left style, left lateral view; 342, connective, left lateral view; 343, connective, anterodorsal view; 344, abdominal apodemes, dorsal view. Scale as in figs. 1–16.

On the basis of the pygofer and aedeagus, *D. jalapensis* is also very closely related to *D. dreisbachi* sp. n. although the pygofer processes in *D. jalapensis* are slightly less robust, directed more anteriorly and lack a sclerotized plate. The aedeagus is also less elongate in *D. jalapensis* with its distal half markedly wider than the basal half and with the gonopore opening between instead of distad of the posterior processes. The abdominal apodemes of the two species are also diagnostic, those of *D. jalapensis* being much narrower and wider apart. Externally, the two species are indistinguishable.

Dikraneura dreisbachi sp. n.

(Text-figs. 345–356)

Length: ♂ 4·36 mm.

Form and colour as in *D. vittata* Borland but paler with anteclypeus and frontoclypeus yellowish, anterior half of longitudinal vittae yellow marked with orange and basal area of fore wings pale pinkish.

Male apodemes elongate, each with length approximately twice width, extending to anterior region of fifth segment.

Male genitalia as in *D. beameri* Borland but with pygofer processes slightly shorter and with fewer teeth, dorsomesal margin of pygofer along apical third with a thin sclerotized plate directed mesally and tapering towards apex of posterior process, and aedeagus with shaft more elongate and tapering near apex to a pair of short anteriorly directed processes as in *D. jalapensis* sp. n., their apices turned mesad, posterior margin at base of tapered section slightly produced and turned dextrally and with posterolateral processes immediately basad of gonopore.

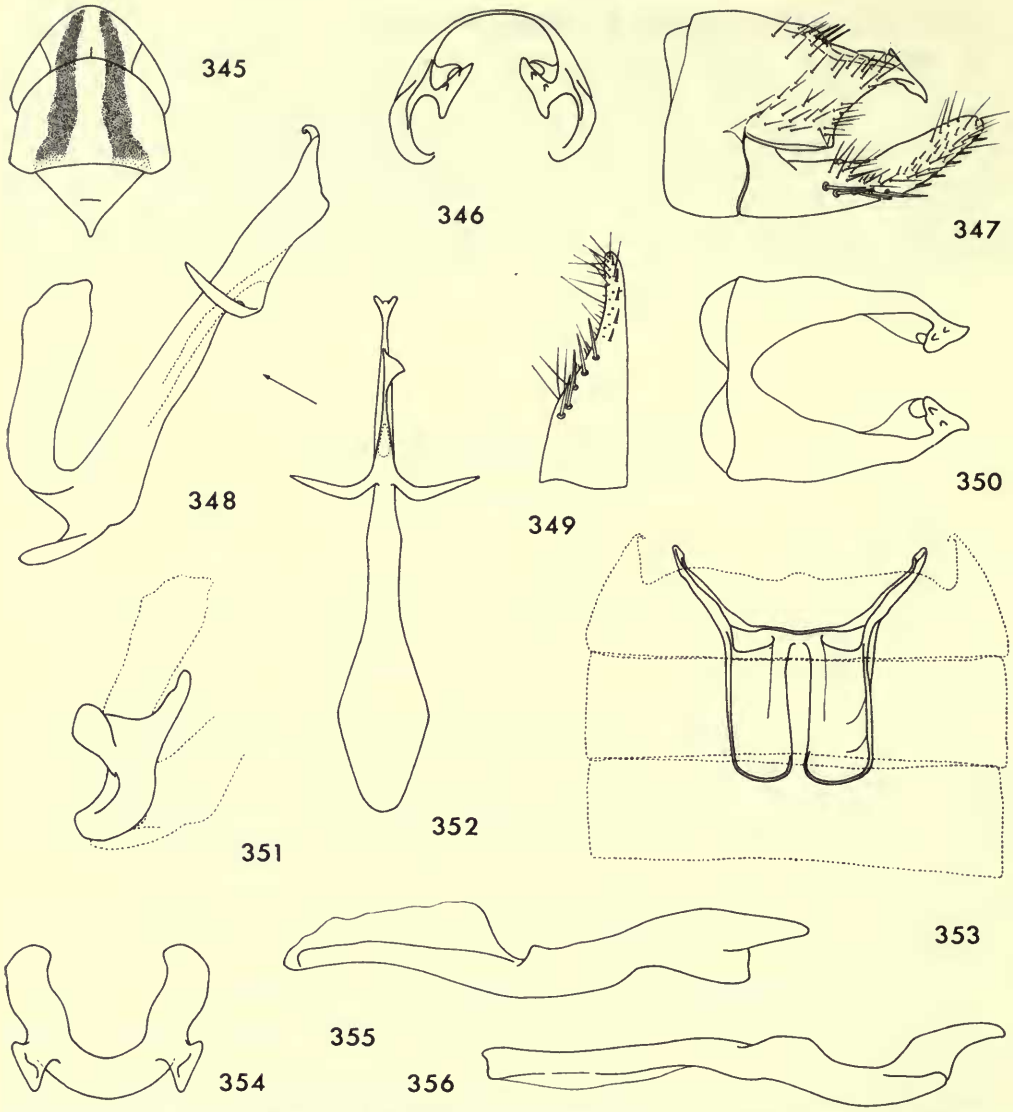
Female unknown.

Holotype ♂. MEXICO: Texpan, 7,500′, 12.viii.54 (*R. R. Dreisbach*), in U.S. National Museum.

This species is named in honour of its collector, R. R. Dreisbach.

Biology. *Dikraneura dreisbachi* is known only from the holotype taken in Mexico in August at 7,500′.

Remarks. *Dikraneura dreisbachi* is similar in male genitalia to both *D. beameri* Borland and *D. jalapensis* sp. n. although more closely related to the latter on the basis of the aedeagus. It differs however from both these species by the relatively shorter pygofer processes, the presence of fewer teeth along the length of the latter, the unique presence of a sclerotized plate dorsomesally at the base of each process and the much wider abdominal apodemes. The aedeagus also differs from that of *D. jalapensis* by being more elongate, of approximately uniform width throughout in lateral aspect and with the gonopore situated distad of, rather than level with, the bases of the posterior processes. Externally, all three species are very similar with the exception that, like *D. jalapensis*, *D. dreisbachi* is much paler than *D. beameri* with the longitudinal vittae on the vertex and pronotum less vivid.



FIGS. 345–356. *Dikraneura dreisbachi* sp. n. 345, head, pronotum and scutellum, dorsal view; 346, male pygofer, posterior view; 347, male pygofer, valve and subgenital plate, left lateral view; 348, aedeagus, left lateral view; 349, left subgenital plate, ventral view; 350, male pygofer, dorsal view; 351, connective, left lateral view; 352, aedeagus, posterior view in direction of arrow in fig. 348; 353, abdominal apodemes, dorsal view; 354, connective, anterior view; 355, left style, dorsal view; 356, left style, left lateral view. Scale as in figs. 1–16.

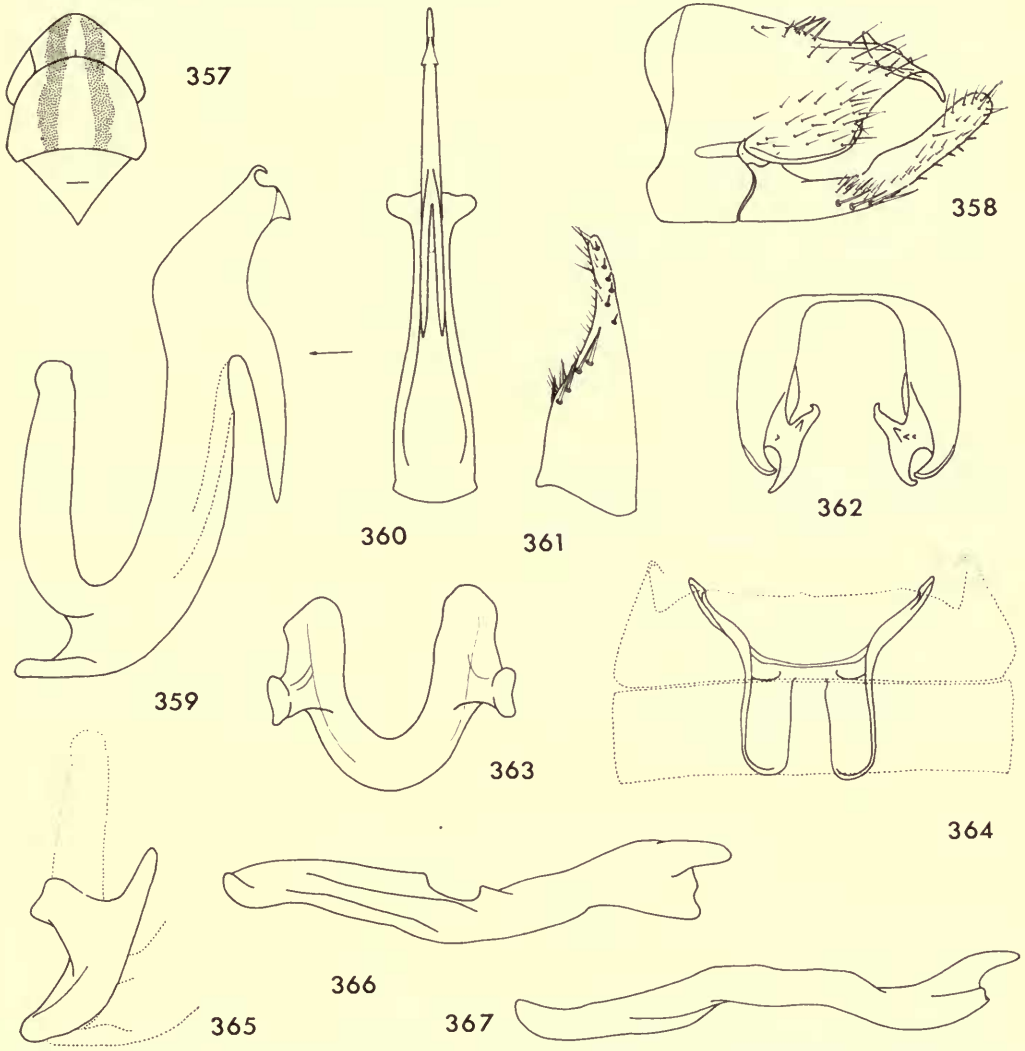
It is possible that *D. dreisbachi* may prove to be simply a variant of *D. jalapensis* sp. n. in the light of additional specimens. In view of the constancy in the shape of the genitalia in related species however, the two are here considered as distinct species.

Dikraneura halberda Ruppel & DeLong

(Text-figs. 357–367)

Dikraneura halberda Ruppel & DeLong, 1953*e* : 350.

Length: ♂ 3·90–4·60 mm. (mean 4·23 mm.).
Form and colour as in *D. vittata* Borland.



FIGS. 357–367. *Dikraneura halberda* Ruppel & DeLong. 357, head, pronotum and scutellum, dorsal view; 358, male pygofer, valve and subgenital plate, left lateral view; 359, aedeagus, left lateral view; 360, aedeagus, posterior view in direction of arrow in fig. 359; 361, left subgenital plate, ventral view; 362, male pygofer, posterodorsal view; 363, connective, anterodorsal view; 364, abdominal apodemes, dorsal view; 365, connective, left lateral view; 366, left style, dorsal view; 367, left style, left lateral view. Scale of head as in fig. 237, rest as in figs. 1–16.

Male apodemes elongate, each with length approximately twice width, extending to posterior margin of fourth segment.

Male genitalia with pygofer as in *D. beameri* Borland but with fewer teeth on dorsal surface of process. Aedeagus with preatrium short; basal apodeme elongate, directed dorsally; shaft elongate, laterally compressed, directed dorsally with distal one-fourth turned slightly posterodorsally with extreme apex finger-like in lateral aspect and hooked posteriorly; a pair of short broadly triangular subapical processes on posterior margin, directed posteriorly and slightly divergent; a pair of elongate, laterally compressed parallel processes posteriorly, approximately one-third distance from apex, directed ventrally; gonopore on posterior margin immediately basad of latter processes.

Female unknown.

Distribution. Mexico (Ruppel & DeLong, 1953*e*).

Specimens seen. MEXICO: W. Cortez Pass, 8,500', 1 ♂, 13.viii.54 (*R. R. Dreisbach*).

The holotype ♂ and 1 ♂ paratype (MEXICO: D. F., Mexico City, 13.ix.39 (*D. M. DeLong*)), 1 ♂ paratype (MEXICO: D. F., Mexico City, 13.ix.39 (*DeLong, Good, Caldwell & Plummer*)), 3 ♂ paratypes (MEXICO: D. F., Chapultepec Mts., MB 150, 16.ii.26 (*A. Dampf*)) and 2 ♂ paratypes (MEXICO: Desierto de los Leones, MF 2913, Mexico City, 8.i.33 (*no collector*)), located in the DeLong Collection, Ohio State University, were also studied.

Biology. *Dikraneura halberda*, known only from Mexico, has been recorded in September, October, November and January and, together with other species of the genus, is considered to be restricted to the pine regions of the higher altitudes (Ruppel & DeLong, 1953*e*). Specimens at hand show it to be present also during August.

Remarks. *Dikraneura halberda* is related to *D. beameri* Borland, *D. jalapensis* sp. n. and *D. dreisbachi* sp. n. in the general shape of the pygofer but is readily distinguished from all these species by the shape of the aedeagus with its unique ventrally directed posterior processes. Externally, it is indistinguishable from either *D. beameri* or *D. vittata* Borland.

Dikraneura stonei Ruppel & DeLong

(Text-figs. 368–377)

Dikraneura stonei Ruppel & DeLong, 1953*e* : 349.

Length: ♂ 3·72 mm.

Form and colour as in *D. vittata* Borland. (Colour of abdomen not obtainable).

Male apodemes and base of abdomen missing from holotype.

Male genitalia with pygofer tapering posteriorly in lateral aspect and terminating in an elongate posteromesally directed process, recurved dorsomesally near its apex and with an elongate process dorsally midway between its base and recurved portion; lateral surface with short setae over posterior half. Aedeagus with preatrium short; basal apodeme well developed, directed dorsally; shaft elongate, directed posterodorsally but slightly sinuous in lateral aspect near midlength, laterally compressed over distal half and tapering in lateral aspect towards a short finger-like process, its apex weakly bifurcate in posteroventral aspect; a pair of thin elongate parallel processes on posterior margin just distad of midlength, directed ventrally, their apices

turned posteriorly; a pair of stouter posterolateral processes immediately basad of latter, directed anterolaterally; gonopore on posterior margin between bases of thinner processes.

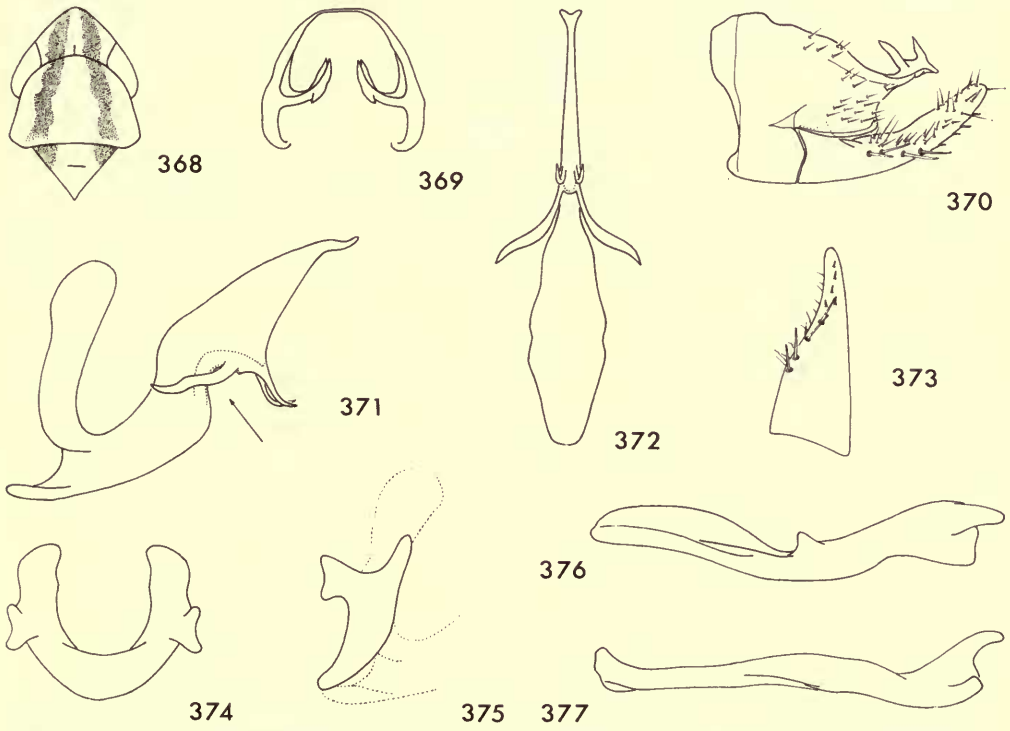
Female unknown.

Distribution. Mexico (Ruppel & DeLong, 1953*e*).

Specimens seen. Only the holotype ♂ (MEXICO: Mexico, Cuernavaca Rd., 20.viii.36 (*Ball & Stone*)), in the U.S. National Museum, was available for study.

Biology. The holotype of *Dikraneura stonei* was taken during August in Mexico. Together with other members of the genus, it is apparently restricted to the pine regions of the higher altitudes (Ruppel & DeLong, 1953*e*).

Remarks. *Dikraneura stonei*, although undoubtedly related to *D. vittata* Borland and *D. beameri* Borland in the general shape of the pygofer and aedeagus, is unique in the shape of the pygofer process and the presence of two pairs of posterior processes near the midlength of the aedeagus, the latter being found in only one other species, *D. denticulata* sp. n. from Nepal. Externally, *D. stonei* is indistinguishable from *D. vittata* although slightly smaller.



FIGS. 368–377. *Dikraneura stonei* Ruppel & DeLong. 368, head, pronotum and scutellum, dorsal view; 369, male pygofer, posterior view; 370, male pygofer, valve and subgenital plate, left lateral view; 371, aedeagus, left lateral view; 372, aedeagus, ventroposterior view in direction of arrow in fig. 371; 373, left subgenital plate, ventral view; 374, connective, anterior view; 375, connective, left lateral view; 376, left style, dorsal view; 377, left style, left lateral view. Scale as in figs. 1–16.

Dikraneura angustata Ball & DeLong

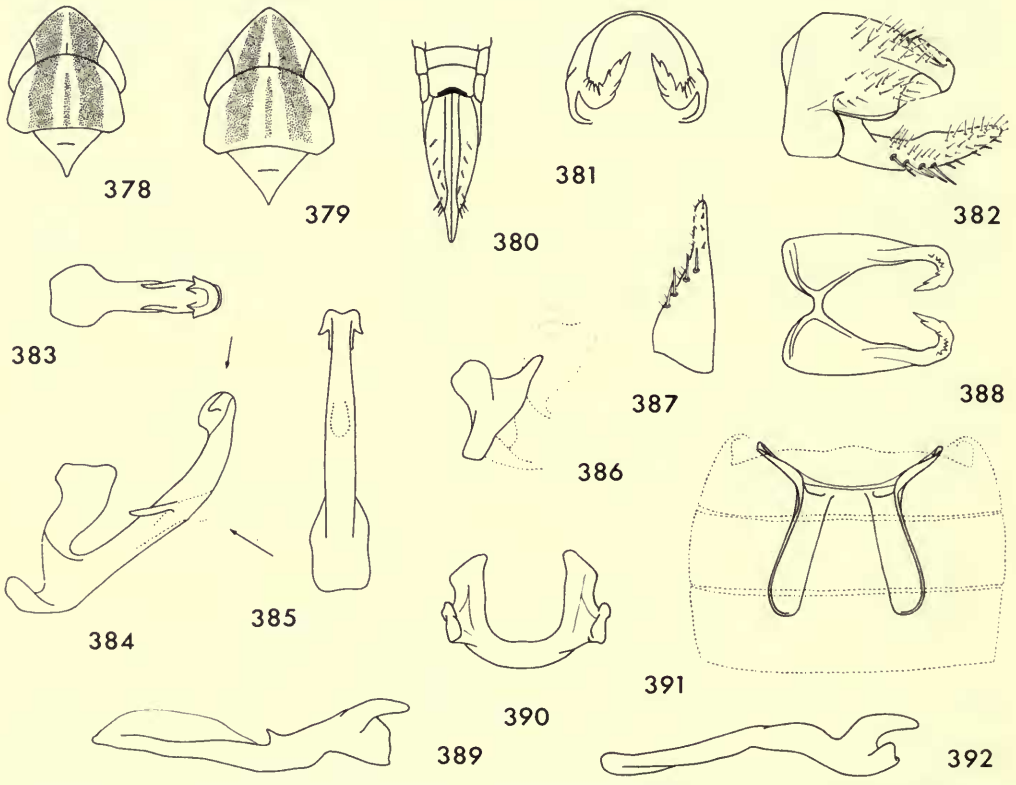
(Text-figs. 378–392)

Dikraneura angustata Ball & Delong, 1925*a* : 328.

Length: ♂ 3·00–3·60 mm. (mean 3·29 mm.). ♀ 3·34–3·80 mm. (mean 3·56 mm.).

Head with width equal to or slightly narrower than that of pronotum, vertex angularly produced with apex broadly rounded in dorsal aspect, more markedly produced and acutely angled in female, medial length approximately twice length next eyes, broadly rounded to face with latter as long as wide, ocellocular area equal in width to antennal fossa; pronotum with width increasing slightly posteriorly.

Colour of face pale brownish, sometimes washed with yellow, frontoclypeus between antennae diffuse reddish brown, often faintly so, lora and genae cream, vertex yellow with medial stripe and occasionally area alongside each eye cream, eyes testaceous. Pronotum cream, disc sordid, a longitudinal vitta on each side of midline, and a much narrower sometimes indistinct



Figs. 378–392. *Dikraneura angustata* Ball & DeLong. 378, head, pronotum and scutellum, dorsal view (male); 379, same (female); 380, female genitalia, ventral view; 381, male pygofer, posterior view; 382, male pygofer, valve and subgenital plate, left lateral view; 383, aedeagus, dorsal view in direction of arrow in fig. 384; 384, aedeagus, left lateral view; 385, aedeagus, posterior view in direction of arrow in fig. 384; 386, connective, left lateral view; 387, left subgenital plate, ventral view; 388, male pygofer, dorsal view; 389, left style, dorsal view; 390, connective, anterodorsal view; 391, abdominal apodemes, dorsal view; 392, left style, left lateral view. Scale as in figs. 1–16.

medial one, yellow, all three, together with vertex on each side of midline, rarely reddish or orange, the outer two often appearing to continue to apex of vertex; scutellum cream with disc in parts and basal angles yellow; remainder of thorax with dorsum dark brown, venter pale stramineous. Legs pale stramineous. Fore wings with basal area subhyaline greenish yellow, usually pale; apical half hyaline with veins creamish. Hind wings hyaline, veins dark brown. Abdomen with dorsum dark brown to black, lateral edge yellow or cream; venter yellow, usually pale, often cream in female; male pygofer and anal tube light brown, occasionally dark brown, valve and subgenital plates concolorous cream; female pygofer cream with dorsum and apex of ovipositor beyond pygofer dark brownish, sternum VII cream with medial emargination edged with brown.

Male apodemes elongate, narrow, each with length approximately $3\frac{1}{2}$–4 times width, usually divergent, rarely parallel, extending to anterior region of fifth segment.

Male genitalia with pygofer tapering posteriorly in lateral aspect and terminating dorsoposteriorly in a stout process curving abruptly anteromesally and slightly dorsally, its dorsal and ventral surface with a row of apposed ridge-like teeth; dorsolateral margin with a small number of spine-like setae near midlength; lateral surface with numerous setae over posterior half. Aedeagus with preatrium short; basal apodeme well developed, directed dorsally and expanding towards apex; shaft elongate, directed dorsoposteriorly with distal third turned slightly more dorsad and terminating in a pair of anteriorly directed flap-like processes, each with a short spur-like process laterally; a pair of short lateral parallel processes near midlength, directed anteriorly; gonopore on posterior margin level with lateral processes.

Female genitalia with posterolateral angles of sternum VII rounded, posterior margin broadly concave with edge of concavity heavily sclerotized.

Distribution. Ontario (Phillips, 1951*a*), Minnesota (Medler, 1943*a*), Iowa (Padley, 1941*a*), Illinois (McAtee, 1926*c*), Ohio (Johnson, 1935*a*), Kansas (Lawson, 1930*c*; Ball & DeLong, 1925*a*), Kentucky (Young, 1949), Tennessee (Ball & DeLong, 1925*a*), North Carolina (Brimley, 1938*a*), South Carolina (Ball & Delong, 1925*a*), Georgia (Fattig, 1955*a*), Texas (Ball & DeLong, 1925*a*), Mexico (McAtee, 1926*b*).

Specimens seen. CANADA: Ont., Pt. Pelee, 2 ♂, 9.ix.1954 (*W. R. M. Mason*); Ont., Portsmouth, 1 ♀, 29.iv.34 (*J. S. Caldwell*). UNITED STATES: Wis., Eagleton, 1 ♂, 29.viii.37 (*R. H. Beamer*); Wis., Blue River, 1 ♀, 28.vii.16 (*D. M. DeLong*); Wis., Amery, 1 ♀, 13.viii.16 (*D. M. DeLong*); Ill., Orland Park, 2 ♀, 13.vii.1946 (*R. H. Beamer*); Ill., Karnak, 1 ♀, 14.vi.1954 (*DeLong & Ross*); Ill., Onarga, 1 ♂, 13.vii.1946 (*R. H. Beamer*); Ill., Urbana, 1 ♂, 14.vii.1946 (*R. H. Beamer*), 2 ♀, 19.ix.1934 (*DeLong & Ross*); Pa., Speeceville, 1 ♀, 22.vii.17 (*J. G. Sanders*); Pa., Penfield, 1 ♀, 24.viii.18 (*J. G. Sanders*); Pa., Landisburg, 1 ♀, 11.vii.18 (*J. G. Sanders*); Pa., Proctor, 1 ♀, 21.vii.18 (*J. G. Sanders*); N. J., Allenhurst, 1 ♂, 2 ♀, 20.vi.19 (*J. G. Sanders*); D. C., 1 ♂, 19.x.39 (*no collector*); D. C., Washington, 2 ♀, 3.vii.19, 1 ♀, 4.xi.06, 1 ♀, 24.x.06, 2 ♀, 25.x.06 (*J. G. Sanders*), 1 ♂, 6.v.34, 1 ♂, 22.ii.32 (*P. W. Oman*); Md., Marshall Hall, 1 ♂, 9.vii.05 (*J. G. Sanders*); Md., Beltsville, 1 ♂, 2 ♀, 21.iv.44 (*G. B. Sartoris*); Md., Plummers Id., 3 ♂, 3 ♀, 25.viii.43, 3 ♂, 1 ♀, 28.viii.43 (*R. H. Beamer*); Md., Ocean City, 1 ♀, 18.vi.18 (*J. G. Sanders*); Va., Arlington, 7 ♂, 1.viii.43, 5 ♂, 5 ♀, 12.ix.43 (*R. H. Beamer*); Va., Battle Pt., 2 ♀, 22.vi.18 (*J. G. Sanders*); Va., Dismal Swamp, 2 ♂, 13.viii.34 (*R. H. Beamer*); Va., Mt. Lake, 2 ♂, 2 ♀, 2.ix.1946 (*R. H. Beamer*); Va., Cp. Charles, 1 ♀, 1.viii.20, 1 ♀, 3.viii.20 (*D. M. DeLong*); Va., Norfolk, 1 ♂, 8.x.32 (*L. D. Anderson*); N. C., Crusoe, 1 ♂, 1 ♀, viii.35 (*Z. P. Metcalf*); N. C., mountains, 1 ♂,

5 ♀, 1937–1938 (*Z. P. Metcalf*); N. C., The Cliffs State Park, 1 ♂, 27.vii.1957, 1 ♀, 30.iv.1959 (*D. A. Young*); N. C., Whiteside Mt., 1 ♂, 6.vi.1957 (*D. A. Young*); N. C., Mt. Airy, 1 ♀, 4.ix.1941 (*R. C. Peeples*); N. C., Sampson Co., 1 ♂, 27.v.1957 (*D. A. Young*); N. C., Morrow Mtn. State Park, 1 ♂, 1 ♀, 20.vi.1958 (*D. A. Young*), 1 ♀, 22.vii.59 (*F. W. Mead*); N. C., Swannanoa, 1 ♂, 1 ♀, 13.viii.1919, 2 ♂, 2 ♀, 29.viii.1919, 1 ♀, 16.viii.1919 (*Osborn & Metcalf*); N. C., Wake Co., 2 ♂, 3 ♀, 23.v.1958 (*D. A. Young*); N. C., Highlands, 3 ♂, 2 ♀, 7.vi.1957, 1 ♀, 5.vi.1957 (*D. A. Young*); N. C., Haywood Co., 4 ♂, 2 ♀, 20.vii.1958 (*D. A. Young*); N. C., Swain Co., 2 ♂, 1 ♀, 28.vii.1958 (*D. A. Young*); N. C., Mt. Pisgah, 1 ♀, 14.viii.1957, 2 ♂, 3 ♀, 17.vii.1958, 1 ♀, 18.vii.1959, 1 ♀, 18.vi.1958, 1 ♂, 18.vii.1958, 2 ♂, 4 ♀, 15.viii.1957 (*D. A. Young*); N. C., Raleigh, 2 ♂, 6 ♀, x.1911 (*no collector*), 1 ♂, 31.viii.1946 (*L. D. Beamer*), 1 ♂, 15.vi.1957 (*D. A. Young*); N. C., Crabtree Meadows Park, 3 ♀, 29.vii.1958 (*D. A. Young*); N. C., Cedar Mt., 1 ♀, 15.viii.1957 (*D. A. Young*); N. C., Robbinsville, 3 ♂, 5 ♀, 24.vii.1958, 1 ♀, 28.vii.1958 (*D. A. Young*); N. C., Graham Co., Hooper bald, 3 ♂, 27.vii.1958 (*D. A. Young*); N. C., Graham Co., 4 ♂, 5 ♀, 28.vii.1958 (*D. A. Young*); Tenn., Hamilton Co., 2 ♂, 1 ♀, 22.x.40 (*W. F. Turner*); Tenn., Byersburg, 1 ♀, 17.vi.15 (*no collector*); Tenn., Clarksville, 2 ♂, 23.vi.15 (*no collector*), 1 ♂, 4.vii.39 (*J. D. Beamer*), 1 ♂, 15.vii.1939 (*R. H. Beamer*); N. C. and Tenn., Roan Mt., 5,500′–6,300′, 1 ♂, 2 ♀, 1/3.ix.1927 (*Z. P. Metcalf*); Ga., Cornelia, 1 ♀, vi.18 (*D. M. DeLong*); Ala., Elgin, 3 ♂, 6.vii.1939 (*R. H. Beamer*); Ark., Fayetteville, 1 ♂, 20.x.1937 (*M. W. Sanderson*); Okla., Alfalfa Co., 1 ♂, 2 ♀, 3.x.1948, 1 ♀, 9.vi.1948, 1 ♂, 23.x.1948, 1 ♀, 5.v.1949 (*S. Coppock*); Kans., Hamilton Co., 3,350′, 1 ♂, vii.1921 (*no collector*); Kans., Douglas Co., 1 ♂, 21.vi.1928, 4 ♂, no date (*P. B. Lawson*), 1 ♂, 26.x.1944 (*R. H. Beamer*); Kans., Pratt Co., 1,900′, 1 ♂, vi.1921 (*no collector*); Kans., Scott Co., S. Pk., 1 ♀, 9.viii.45 (*R. H. Beamer*); Kans., Leavenworth Co., 1 ♂, 6.v.39 (*D. E. Hardy*); Kans., Cherokee Co., 1 ♂, 20.iv.35, 1 ♂, 30.viii.39, 2 ♂, 5 ♀, 18.ix.1945, 1 ♀, 19.ix.45 (*R. H. Beamer*); Kans., Lawrence, 4 ♂, 14.v.39 (*L. Lipovsky*); Kans., La Cygne, 2 ♂, 12.x.1948, 1 ♂, 14.x.1948, 1 ♂, 20.x.1948 (*R. H. Beamer*); Mo., Hollister, 1 ♀, 22.vii.1915 (*H. H. Knight*); Texas, San Antonio, 4 ♂, 25.vi.38 (*R. H. Beamer*); Texas, Dallas, 2 ♂, 5.xii.1945 (*R. H. Beamer*); Texas, Sarita, 1 ♀, 25.xii.1945 (*R. H. Beamer*); Texas, Crosby, 1 ♂, 27.iv.1953 (*R. H. Beamer*); Colo., Holly, 2 ♂, 6.ix.38 (*D. E. Hardy*).

New Records: Pennsylvania, New Jersey, District of Columbia, Maryland, Virginia, Alabama, Wisconsin, Arkansas, Oklahoma, Colorado, Missouri.

Of the original type series, seventeen specimens present in the DeLong Collection, Ohio State University, (UNITED STATES: Tenn., Knoxville, 204, 2 ♂, 1 ♀, 13.ix.15 (*no collector*); Tenn., Clarksville, 115, 2 ♂, 1 ♀, 14.vii.15 (*no collector*); Tenn., Clarksville, 109, 1 ♂, 9.vii.15 (*no collector*); Tenn., Clarksville, 108, 1 ♂, 6.vii.15 (*no collector*); Tenn., Clarksville, 100, 2 ♀, 5.vii.15 (*no collector*); Tenn., Clarksville, 116, 1 ♀, 14.ix.15 (*no collector*); Tenn., Clarksville, 183, 1 ♀, 25.x.15 (*no collector*); Tenn., Clarksville, 1 ♀, 31.x.15 (*D. M. DeLong*); Tenn., Knoxville, 2 ♀, 13.ix.15 (*D. M. DeLong*); Tenn., Knoxville, 206, 1 ♀, 13.ix.15 (*no collector*); Tenn., Memphis, 45, 1 ♀, 21.vi.15 (*no collector*)) were also studied. Of these specimens, the male

labelled " Clarksville, Tenn., 7–6–15 108 " is here designated as LECTOTYPE and the remaining specimens as PARALECTOTYPES.

Biology. *Dikraneura angustata* is active from early spring to late summer and is recorded during May in Illinois (McAtee, 1926*c*), Ohio (Johnson, 1935*a*) and Kentucky (Young, 1949) and even as early as April in Georgia (Fattig, 1955*a*). Specimens at hand show it to be present during April also in Ontario, Maryland, North Carolina, Kansas and Texas and even as early as February in District of Columbia. Its latest recorded appearance is October in Ohio (Johnson, 1935*a*) and North Carolina (Brimley, 1938*a*) and present specimens indicate this month also for District of Columbia, Virginia, North Carolina, Tennessee, Arkansas, Oklahoma and Kansas. Specimens are also at hand for November in District of Columbia and December for Texas. McAtee (1926*c*) records it on Locust in Illinois while Phillips (1951*a*) gives its hosts as grasses in Sour Cherry orchards in Ontario.

Remarks. *Dikraneura angustata* is closely related to the following species, *D. torta* DeLong & Caldwell, especially in the shape of the male genitalia. *D. angustata*, however, may be distinguished by the shorter and more robust form of the pygofer with the posterior processes stouter, and the teeth more ridge-like and closer together rather than separate and distinct. The aedeagus is also relatively shorter, less tapered in posterior aspect, with the apical flap-like processes more broadly rounded in lateral aspect and with the gonopore level with rather than basad of lateral processes. The two species are further distinguished by the shorter, relatively narrower and more divergent abdominal apodemes in *D. angustata*. Externally, the two species are easily distinguished by the larger size of *D. torta*, the difference in colouration and the shape of the head and pronotum.

D. angustata is similar externally to *D. abnormis* (Walsh) but is smaller, with the apex of the vertex more obtusely angled and with slightly different colouration. The male genitalia of both species are distinct.

Dikraneura torta DeLong & Caldwell

(Text-figs. 393–407)

Dikraneura (*Notus*) *torta* DeLong & Caldwell, 1937*a* : 25.

Length: ♂ 3·70–4·00 mm. (mean 3·77 mm.). ♀ 3·76–3·96 mm. (mean 3·90 mm.).

Head with width greater than that of pronotum, vertex moderately produced with apex broadly rounded in dorsal aspect, more markedly produced and acutely rounded in female, medial length approximately 1½ times length next eyes, broadly rounded to face with latter as long as wide, ocellocular area equal in width to antennal fossa; pronotum with sides parallel.

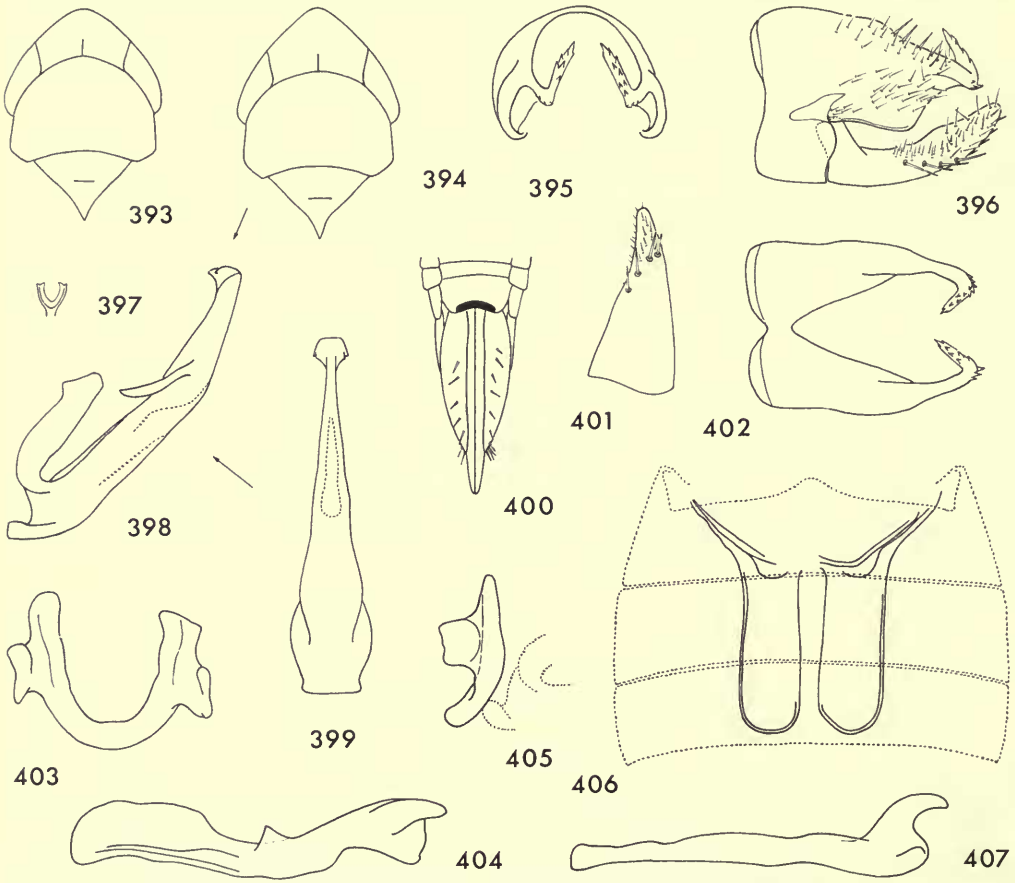
Colour of face sordid yellow or cream, lora, genae and vertex cream, eyes testaceous. Pronotum cream, disc sordid pale pinkish, with three faintly indicated longitudinal vittae, one medial and one over each lateral edge of disc, yellowish, the outer two rarely extending onto vertex; scutellum cream with basal angles and disc anterior to transverse suture, yellow; remainder of thorax pale yellowish or creamish. Legs pale stramineous. Fore wings with basal area subhyaline pale orange, rarely pale greenish yellow, with internal edge of clavus, claval vein, claval suture and *Cu* and *M* to base of apical cells, whitish; apical half hyaline,

faintly smoked with brown, veins creamish. Hind wings hyaline, veins dark brown. Male abdomen with dorsum dark brown, lateral margin yellow, venter yellow, pygofer pale brown with subgenital plates cream; female abdomen uniformly pale yellowish or creamish with edge of medial emargination of sternum VII light brown.

Male apodemes elongate, each with length approximately $2\frac{1}{2}$ times width, extending to posterior region of fifth segment.

Male genitalia as in *D. angustata* Ball & DeLong but with pygofer more elongate, pygofer process more slender and with teeth much smaller and restricted to elbow and recurved portion, and the aedeagus more elongate, more tapered in posterior aspect and with apical flap-like processes more acute, apical spur-like processes smaller and lateral processes distad of gonopore.

Female genitalia with sternum VII as in *D. angustata* Ball & DeLong but relatively wider.



FIGS. 393–407. *Dikraneura torta* DeLong & Caldwell. 393, head, pronotum and scutellum, dorsal view (male); 394, same (female); 395, male pygofer, posterior view; 396, male pygofer, valve and subgenital plate, left lateral view; 397, apical processes of aedeagus, dorsal view in direction of arrow in fig. 398; 398, aedeagus, left lateral view; 399, aedeagus, posteroventral view in direction of arrow in fig. 398; 400, female genitalia, ventral view; 401, left subgenital plate, ventral view; 402, male pygofer, dorsal view; 403, connective, anterior view; 404, left style, dorsal view; 405, connective, left lateral view; 406, abdominal apodemes, dorsal view; 407, left style, left lateral view. Scale as in figs. 1–16.

Distribution. Arizona (DeLong & Caldwell, 1937*a*).

Specimens seen. UNITED STATES: Ariz., Mt. Lemon, 1 ♂, 4 ♀, 29.iv.1948 (*R. H. Beamer*).

The holotype ♂ and 1 ♂ paratype (UNITED STATES: Ariz., Chiricahua Mts., 9.vi.33 (*R. H. Beamer*)), located in the Snow Museum, University of Kansas, and 1 ♂ paratype (same data), located in the DeLong Collection, Ohio State University, were also studied. The male paratype in the Snow Museum is abnormal, possibly parasitized.

Biology. Restricted to Arizona, *D. torta* has been previously recorded only during June (DeLong & Caldwell, 1937*a*). Present specimens show it to be present also during April.

Remarks. Although *D. torta* is larger and less slender than *D. angustata* Ball & DeLong and differs also in colouration and the shape of the head and pronotum, making them easily distinguishable externally, the two species are closely related on the basis of the male genitalia. The latter are sufficiently distinct, however, to permit recognition and are discussed under *D. angustata*.

The restriction of *D. torta* to Arizona, compared with the widespread distribution of *D. angustata* Ball & DeLong over the eastern half of the United States, suggests that *D. torta* may be a subspecies of the latter. In view of their marked external differences, however, and the absence of a longer series of *D. torta* preventing a more critical study, they are here considered as distinct species.

Dikraneura arcta DeLong & Caldwell

(Text-figs. 408–413)

Dikraneura (*Notus*) *arcta* DeLong & Caldwell, 1937*a* : 29.

Length: ♂ 3·20 mm.

Head with width equal to that of pronotum, vertex angularly produced with medial length approximately twice length next eyes, apex narrowly rounded in dorsal aspect; pronotum with width increasing posteriorly.

Colour of head yellow, paling laterally over genae to cream. Pronotum cream with a longitudinal vitta on each side of midline and a much narrower medial one, pale yellow; scutellum cream with basal angles and medial area pale yellow; remainder of thorax yellowish. Legs cream. Fore wings with basal area pale greenish yellow opaque; apical area hyaline. (Colour of abdomen not obtainable).

Male apodemes elongate, length of each 3 times width, divergent, extending to posterior margin of fifth segment.

Male genitalia as in *D. angustata* Ball & DeLong but with pygofer more elongate, posterior processes more slender, directed more anteriorly and with teeth smaller and restricted to recurved portion and with aedeagus straight, tapering distally and with lateral processes markedly distad of gonopore and diverging anterolaterally. (Apex of aedeagus missing in holotype).

Female unknown.

Distribution. Arizona (DeLong & Caldwell, 1937*a*).

Specimens seen. Holotype ♂, UNITED STATES: Ariz., Red Lake, 5.viii.33 (*R. H. Beamer*), in Snow Museum, University of Kansas.

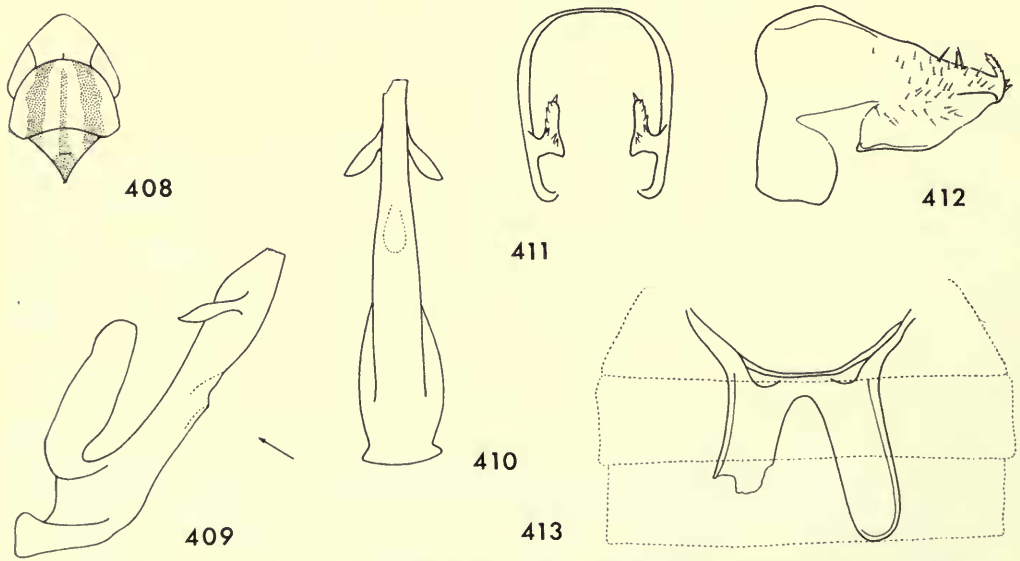
Biology. *Dikraneura arcta* is known only by its holotype, taken during August in Arizona (DeLong & Caldwell, 1937*a*).

Remarks. The exact shape of the aedeagus in *Dikraneura arcta* is not known since the apex in the only available specimen (the holotype) is broken off. The original description of the aedeagus possessing a "bluntly pointed tip" is therefore incorrect.

Dikraneura arcta is closely related to *D. angustata* Ball & DeLong in the general shape of the aedeagus and pygofer as well as the elongate divergent abdominal apodemes, the shape of the vertex and the presence of lateral and medial vittae on the pronotum. *D. arcta* differs, however, in having the lateral processes of the aedeagus markedly distad of the gonopore and directed anterolaterally, rather than level with the gonopore and directed anteriorly, and the posterior processes of the pygofer more elongate and recurved anteriorly rather than anteromesally, with the teeth relatively smaller and more isolated from one another.

In the position of the lateral processes of the aedeagus, as well as the shape and ornamentation of the pygofer processes, *D. arcta* is more similar to *D. torta* DeLong & Caldwell, the other species closely related to *D. angustata* Ball & DeLong. It differs from *D. torta* however in having the aedeagus straight, rather than turned dorsad over its apical half, the lateral processes directed anterolaterally rather than anteriorly, and the abdominal apodemes divergent, as well as in overall size, the shape of the vertex and the presence of the longitudinal vittae on the pronotum.

Further specimens are necessary before the true relationship between these three species can be assessed. At the moment *D. arcta* and *D. torta* DeLong & Caldwell



FIGS. 408–413. *Dikraneura arcta* DeLong & Caldwell. 408, head, pronotum and scutellum, dorsal view; 409, aedeagus, left lateral view; 410, aedeagus, posterior view in direction of arrow in fig. 409; 411, male pygofer, dorsoposterior view; 412, male pygofer and valve, left lateral view; 413, abdominal apodemes, dorsal view. Scale as in figs. 237–242.

are known from only one and three males respectively, taken in Arizona, compared with the widely distributed *D. angustata* Ball & DeLong.

Dikraneura ardea Ruppel & DeLong

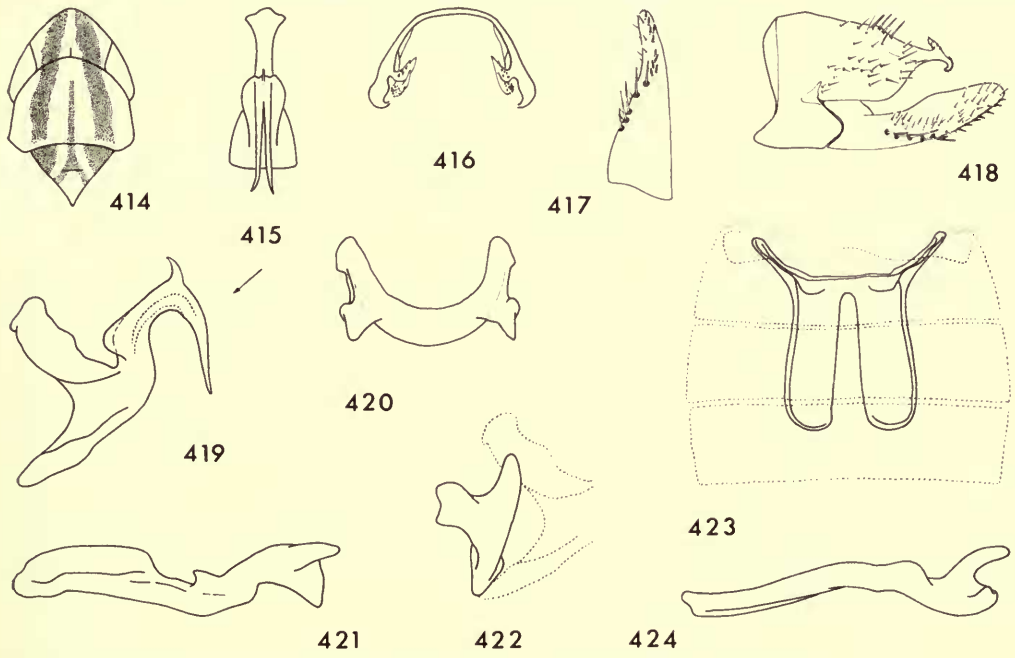
(Text-figs. 414–424)

Dikraneura ardea Ruppel & DeLong, 1953*e* : 350.

Length: ♂ 3·60–4·20 mm. (mean 3·90 mm.).

Head with width approximately equal to or slightly narrower than that of pronotum, vertex moderately produced with apex broadly or narrowly rounded in dorsal aspect, medial length 1½ times length next eyes, broadly rounded to face with latter slightly longer than wide, ocell-ocular area equal in width to antennal fossa; pronotum with width increasing only slightly posteriorly.

Colour of face pale brownish washed with yellow, lora and genae cream, eyes testaceous; vertex and pronotum cream with a longitudinal vitta on each side of midline, from apex of vertex to posterior margin of pronotum, and a much narrower medial one over pronotum, red or orange; disc of pronotum sordid pale pinkish. Scutellum cream with basal angles and a medial streak, bifurcating posteriorly over transverse suture, orange; remainder of thorax with dorsum dark brown, venter pale stramineous. Legs pale stramineous. Fore wings with basal



FIGS. 414–424. *Dikraneura ardea* Ruppel & DeLong. 414, head, pronotum and scutellum, dorsal view; 415, aedeagus, dorsoposterior view in direction of arrow in fig. 419; 416, male pygofer, posterior view; 417, left subgenital plate, ventral view; 418, male pygofer, valve and subgenital plate, left lateral view; 419, aedeagus, left lateral view; 420, connective, anterior view; 421, left style, dorsal view; 422, connective, left lateral view; 423, abdominal apodemes, dorsal view; 424, left style, left lateral view. Scale as in figs. 1–16.

area subhyaline greenish yellow or red, claval vein, claval suture and *Cu* to base of apical cell, whitish; apical half hyaline, pale smoky brown, veins yellowish cream. Hind wings hyaline, veins dark brown. (Colour of abdomen not obtainable).

Male apodemes elongate, each with length 2–3 times width, extending to near middle of fifth segment.

Male genitalia with pygofer as in *D. angustata* Ball & DeLong but more elongate, with posterior processes much smaller and more slender and with recurved portion and ventrally produced elbow with much smaller teeth. Aedeagus with preatrium poorly developed; basal apodeme well developed, directed anterodorsally; shaft relatively short, directed dorsally at base and then strongly arched posteriorly and finally ventrally terminating in a pair of elongate processes directed ventrally in line with shaft, the entire structure appearing more or less S-shaped in lateral aspect; a short acute process medially on dorsal surface of shaft just before apex, directed dorsally; a pair of short thin plate-like lobes anterolaterally near base of shaft, directed anteriorly, their bases long and extending along approximately one-third length of shaft; gonopore apical between bases of apical processes.

Female unknown.

Distribution. Mexico (Ruppel & DeLong, 1953*e*).

Specimens seen. MEXICO: Vera Cruz, 9 miles N.W. Jalapa, 1 ♂, 31.xii.1949 (*R. H. Beamer*). This specimen was originally designated as a paratype of *D. beameri* Borland and is located in the Snow Museum, University of Kansas.

The holotype ♂ (MEXICO: Mich., Zamora, 2.x.1941 (*DeLong, Good, Caldwell & Plummer*)), located in the DeLong Collection, Ohio State University, was also studied.

Biology. *Dikraneura ardea* has been previously recorded only once, during October in Mexico where it is apparently restricted to the pine regions of the higher altitudes (Ruppel & DeLong, 1953*e*). Specimens at hand indicate its presence also in December.

Remarks. *Dikraneura ardea* is similar in external appearance to the majority of other species of the genus found in Mexico but may be distinguished by the additional medial stripe along the pronotum and by the unique S-shaped aedeagus. *D. angustata* Ball & DeLong, which extends south into Mexico and resembles *D. ardea* in general shape and size and by the presence of a medial stripe on the pronotum, may be distinguished from the present species by being slightly smaller, having the longitudinal vittae usually yellow rather than red and above all by the male genitalia.

Although unique in the shape of the aedeagus, *D. ardea* is seen to be related to the majority of other species occuring in Mexico and the southwestern area of the United States by the shape of the male pygofer.

Dikraneura robusta Lawson

(Text-figs. 425–439)

Dikraneura robusta Lawson, 1930*e* : 41.
Dikraneura lentus DeLong, 1938*b* : 218. **syn. n.**
Dikraneura lentana DeLong [n.n. for *lentus* DeLong (homonym)], 1944 : 272.

Length: ♂ 3·60–3·86 mm. (mean 3·74 mm.). ♀ 3·94–4·64 mm. (mean 4·30 mm.).

Head with width greater than that of pronotum, vertex of uniform length or only slightly produced with medial length $1\frac{1}{4}$ times length next eyes in male, apex broadly rounded in dorsal aspect, moderately produced in female with medial length $1\frac{1}{2}$ times length next eyes, broadly rounded to face with latter wider than long, frontoclypeus slightly tumid and ocellocular area $1\frac{1}{2}$ times width of antennal fossa; pronotum with width increasing only very slightly posteriorly or sides parallel.

Colour of head pale brownish or orange-yellow, paling slightly over vertex to sordid cream along posterior edge, marginal sutures orange, lora and genae whitish cream with pit near centre of latter dark brown; anteclypeus pale yellow; eyes testaceous. Pronotum whitish cream overlaid on anterior half with sordid pale yellow, disc sordid; scutellum yellow; remainder of thorax dark brown marked laterally with yellow. Legs pale stramineous. Fore wings with clavus, cubital cell and basal area of costal margin subhyaline pale greenish yellow or whitish; apical half hyaline, with extreme apex smoky pale brown, veins whitish. Hind wings hyaline, veins dark brown. Abdomen with dorsum dark brown to black, lateral edge usually yellow, venter dark brown to black, sternites with posterior and occasionally lateral edge yellow; male pygofer and anal tube dark brown, valve brown to dark brown occasionally cream, subgenital plates cream; female pygofer pale yellow or creamish with dorsum and apex of ovipositor beyond pygofer dark brown, sternum VII pale yellowish or creamish.

Male apodemes elongate, each with length approximately $2\frac{1}{2}$ times width, extending to middle of fifth segment.

Male genitalia with pygofer large and elongate, without processes but with posterior margin expanded as a large thick posteriorly directed lobe, its length approximately equal to one-third total length of pygofer; dorsolateral margin with a group of spine-like setae near mid-length; lateral surface with numerous long hair-like setae over medial area to base of posterior lobe. Subgenital plates with uniseriate row of spine-like setae along ventrolateral margin of uniform length, extending round apex. Aedeagus with preatrium absent; basal apodeme well developed, directed dorsally; shaft elongate, directed posterodorsally and terminating in two pairs of apical processes, a narrow elongate posterior pair directed posteriorly and then anteroventrally parallel to shaft, their apices turned slightly laterad, and a slightly larger anterior pair directed dorsoposteriorly in line with shaft and then abruptly dorsally and slightly laterally, their apices strongly divergent and turned laterad; gonopore apical between bases of apical processes.

Female genitalia with posterolateral angles of sternum VII broadly rounded, posterior margin straight or slightly concave medially with base of concavity rarely produced.

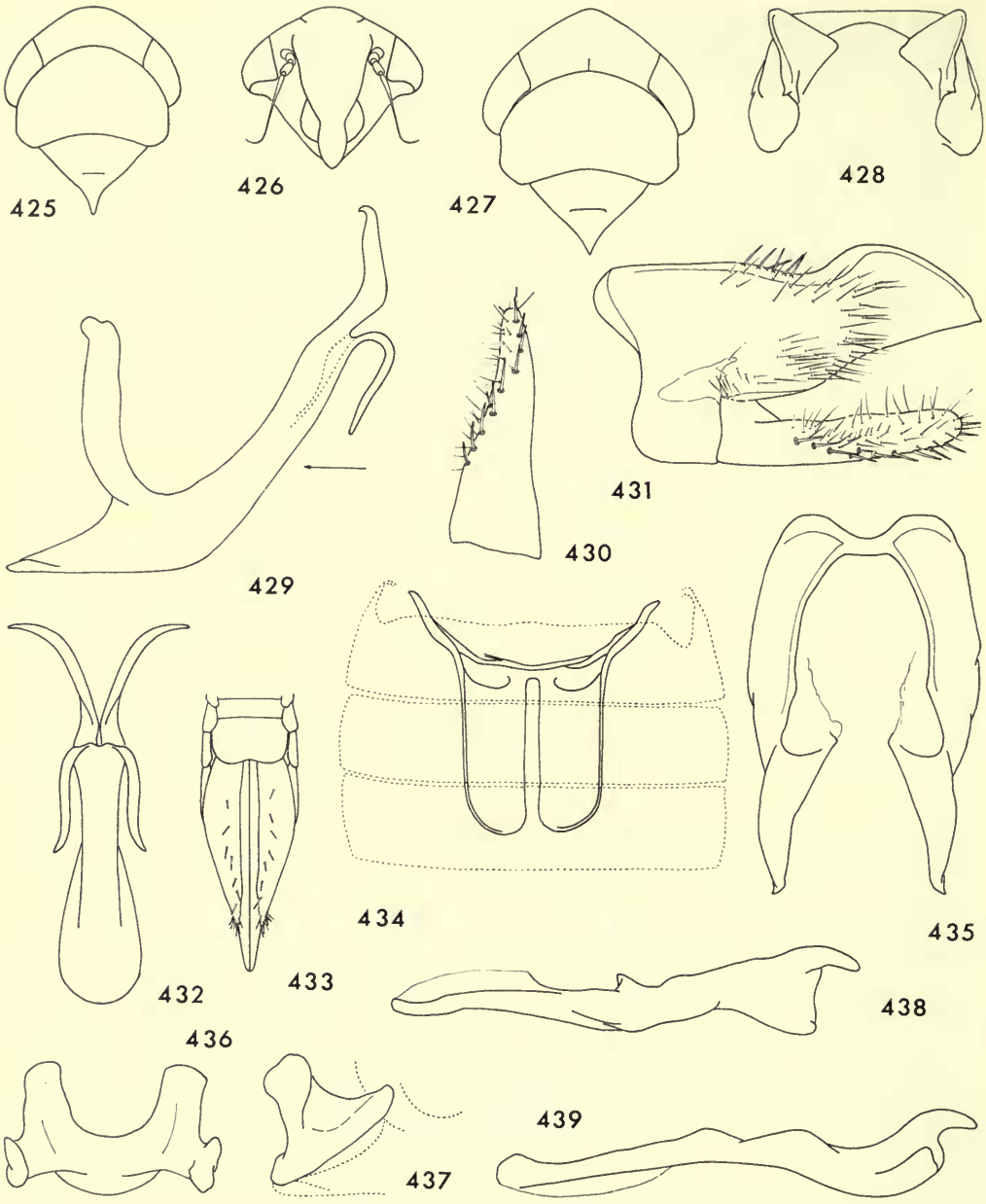
Distribution. Colorado (Lawson, 1930*e*), Arizona (DeLong, 1938*b*), New Mexico (Beamer, 1943*b*).

Specimens seen. UNITED STATES: Colo., Pingree Park, 1 ♂, 5 ♀, 18.viii.32 (*P. B. Lawson*); N. M., Chama, 5 ♂, 5.vii.37 (*C. L. Johnston*), 11 ♀, 5.vii.1937 (*L. D. Tuthill*); Ariz., Flagstaff, 8 ♂, 1 ♀, 8.vii.41 (*R. H. Beamer*).

The holotype ♂ (UNITED STATES: Colo., Creede, 8,844′, viii.1914 (*no collector*)), in the Snow Museum, University of Kansas, was studied. The allotype ♀, 18 ♂, 33 ♀ parallotypes (UNITED STATES: N. M., Chama, 5.vii.37 (*C. L. Johnston*)) and 1 ♀ parallotype (UNITED STATES: Colo., Creede, 6.vii.37 (*R. H. Beamer*)), also in the Snow Museum, were not listed in the original description.

The holotype ♂, allotype ♀ and 29 ♂, 25 ♀ paratypes (UNITED STATES: Ariz., Santa Rita Mts., White Mts., 5.vii.35 (*F. H. Parker*)) of *D. lentana* DeLong, located in the DeLong Collection, Ohio State University, were also studied.

Biology. *Dikraneura robusta* has been recorded during July in Arizona (DeLong, 1938*b*) and New Mexico (Beamer, 1943*b*) and August in Colorado (Lawson, 1930*e*),



FIGS. 425–439. *Dikraneura robusta* Lawson. 425, head, pronotum and scutellum, dorsal view (male); 426, face; 427, head, pronotum and scutellum, dorsal view (female); 428, male pygofer, posterior view; 429, aedeagus, left lateral view; 430, left subgenital plate, ventral view; 431, male pygofer, valve and subgenital plate, left lateral view; 432, aedeagus, posterior view in direction of arrow in fig. 429; 433, female genitalia, ventral view; 434, abdominal apodemes, dorsal view; 435, male pygofer, dorsal view; 436, connective, anterodorsal view; 437, connective, left lateral view; 438, left style, dorsal view; 439, left style, left lateral view. Scale as in figs. 1–16.

having been taken in the latter state at an elevation of 8,844′. Data from specimens at hand substantiate these records.

Remarks. *Dikraneura robusta* is similar to *D. triangulata* sp. n. in both colour and the shape of the vertex and face, the latter being unusual for the genus and found, to a lesser degree, in only one other species, *D. latacephala* Beamer. *D. robusta*, however, is much smaller than *D. triangulata* and with distinctly different male genitalia indicating the absence of any close relationship between the two species.

D. mali (Provancher) is the only other species without posterior processes on the pygofer but the rest of the genitalia show no evident relationship to those of *D. robusta* indicating the independent loss of the processes in each case.

The shape of the aedeagus of *D. robusta* is of the same general form to that found in *D. variata* Hardy, *D. ossia* Beirne, *D. shoshone* DeLong & Caldwell and related, species although the pygofer, abdominal apodemes and head set it apart from any of these species. In spite of the unique pygofer, it is perhaps most closely related to *D. latacephala* Beamer on the basis of the face in particular and the shape of the abdominal apodemes and aedeagus.

Dikraneura mali (Provancher)

(Text-figs. 440–453)

Erythroneura mali Provancher, 1890*a* : 298.
Dicraneura communis Gillette, 1898*a* : 718.

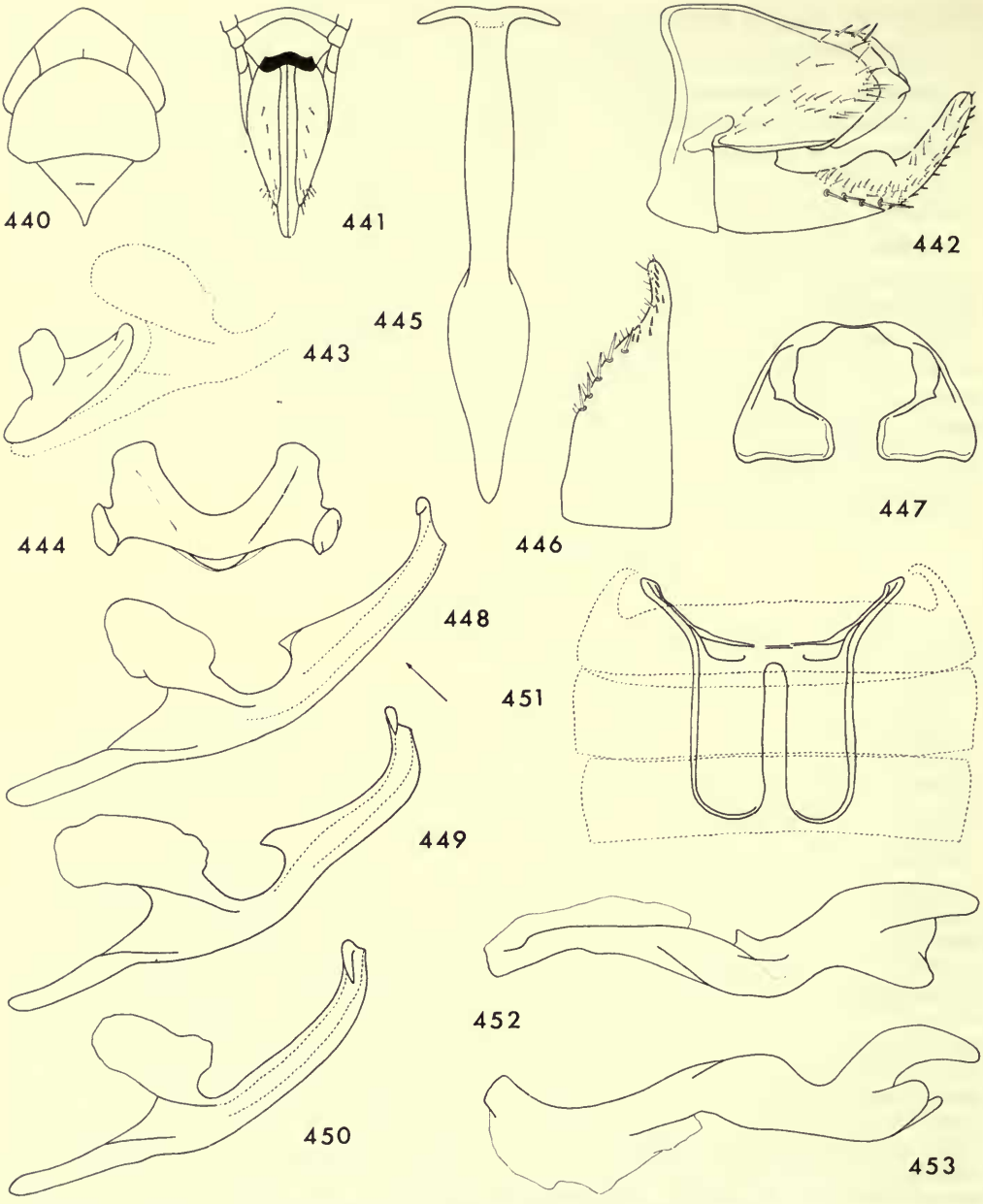
Length: ♂ 3·54–4·02 mm. (mean 3·82 mm.). ♀ 3·58–4·22 mm. (mean 3·97 mm.).

Head with width greater than that of pronotum, vertex angularly produced with apex rounded in dorsal aspect, medial length approximately 1½ times length next eyes, narrowly or broadly rounded to face with latter approximately as long as wide, ocellocular area equal to or slightly wider than antennal fossa; pronotum with width increasing only slightly posteriorly or parallel sided.

Colour of head cream, paling laterally over genae to whitish cream, frontoclypeus below level of antennae usually and anteclypeus sometimes pale yellowish or brownish, marginal sutures and two small patches on vertex, one on each side of midline just behind apex, pale yellowish and sometimes indistinct; eyes testaceous. Pronotum whitish cream, disc sordid, a large patch over anterior two-thirds on each side of midline, yellowish and sometimes indistinct; scutellum whitish cream, basal angles yellow; remainder of thorax dark brown marked laterally with yellow. Legs pale stramineous. Fore wings with basal area subhyaline greenish yellow, usually very pale; apical half hyaline with extreme apex smoky pale brown, veins whitish. Hind wings hyaline, veins whitish. Abdomen with dorsum dark brown to black, lateral edge along entire length or on posterior segments only, yellow, venter dark brown to black with posterior and sometimes also lateral edge of sternites yellow, entire venter often pale yellow; male pygofer and anal tube brown to dark brown, former sometimes paling ventrally, valve and subgenital plates concolorous cream, occasionally yellow and sometimes washed with orange, rarely smoky; female pygofer cream with dorsum and apex of ovipositor beyond pygofer dark brown, sternum VII cream with posterior margin brown.

Male apodemes elongate, each with length approximately twice width, extending to near posterior margin of fifth segment.

Male genitalia with pygofer rounded posteriorly with dorsoposterior margin heavily sclerotized, ventroposterior margin converging medially, posterior margin produced medially in lateral aspect as a very short conical projection; dorsolateral margin with a small group of spine-like setae just distad of midlength; lateral surface with short hair-like setae over posterior half.



FIGS. 440–453. *Dikraneura mali* (Provancher). 440, head, pronotum and scutellum, dorsal view; 441, female genitalia, ventral view; 442, male pygofer, valve and subgenital plate, left lateral view; 443, connective, left lateral view; 444, connective, anterodorsal view; 445, aedeagus, posteroventral view in direction of arrow in fig. 448; 446, left subgenital plate, ventral view; 447, male pygofer, posterior view; 448, aedeagus (Ames, Iowa), left lateral view; 449, same (Livingston Co., Michigan); 450, same (Keld, Manitoba); 451, abdominal apodemes, dorsal view; 452, left style, dorsal view; 453, left style, left lateral view. Scale as in figs. 1–16.

Subgenital plates much broader in ventral aspect than usual. Aedeagus with preatrium well developed; basal apodeme short, laterally compressed, oval in lateral aspect and directed anterodorsally; shaft elongate cylindrical, directed posterodorsally and terminating at anterior margin in a pair of short laterally directed processes, anterior margin usually acutely produced approximately one-third distance from base, projection sometimes rounded at apex and rarely absent; gonopore apical, immediately posterior to apical processes.

Female genitalia with lateral margins of sternum VII strongly convergent and broadly rounded to a broadly and moderately concave posterior margin, the latter heavily sclerotized.

Distribution. British Columbia (Downes, 1919*a*, 1927*a*), Alberta (Strickland, 1953*a*), Manitoba (Bird, 1930*a*), South Dakota (Severin, 1921*c*), Colorado (Gillette, 1898*a*; Ball & DeLong, 1925*a*), Minnesota (Medler, 1943*a*), Iowa (Ball & DeLong, 1925*a*; Padley, 1941*a*), Illinois (Gillette, 1898*a*; Ball & DeLong, 1925*a*; DeLong, 1948*a*), Wisconsin (Sanders & DeLong, 1917*a*; Ball & DeLong, 1925*a*), Michigan (Gillette, 1898*a*; Pettit, 1922*a*; Ball & DeLong, 1925*a*), Ontario (Phillips, 1951*a*), Ohio (Osborn, 1904*a*; Ball & DeLong, 1925*a*; Johnson, 1935*a*), Pennsylvania, (DeLong, 1923*b*; Ball & DeLong, 1925*a*), New York (Gillette, 1898*a*; Van Duzee, 1905*a*; Young, 1910*a*; Osborn, 1922*c*; Ball & DeLong, 1925*a*; Leonard, 1928*a*), Connecticut (Britton, 1920*a*; DeLong, 1923*a*; Ball & DeLong, 1925*a*), New Hampshire (Lowry, 1933*a*), Maine (Osborn, 1915*a*; Ball & DeLong, 1925*a*; Procter, 1946*a*), Quebec (Provancher, 1890*a*; Moore, 1907*a*, 1944*a*, 1950*a*), Nova Scotia (McAtee, 1918*b*).

Specimens seen. CANADA: Sask., Indian Head, 1 ♀, 6.ix.1929 (*K. Stewart*); Man., Keld, 2 ♂, 8.viii.37 (*R. H. Beamer*); Ont., Vineland, 4 ♂, viii.1922, 2 ♂, 10.ix.1922 (*W. Robinson*); Ont., Carp, 1 ♀, 20.v.1954 (*R. Hollinsworth*); Ont., Ottawa, 1 ♂, 1 ♀, 12.v.1955 (*L. A. Kelton*), 1 ♀, 5.v.1952 (*J. G. Chillcott*), 1 ♂, 5.iv.1950 (*R. deRuette*); Ont., Marmora, 3 ♀, 30.iv.1952 (*J. F. McAlpine*); Ont., Maynooth, 1 ♀, 4.ix.1953, 1 ♀, 6.ix.1953 (*B. P. Beirne*); Que., Kirks Ferry, 2 ♂, 2 ♀, 25.v.50 (*B. P. Beirne*); Que., Aylmer, 1 ♀, 19.v.1927 (*G. S. Whalley*); N .B., Fredericton, 1 ♂, 5.vi.1932 (*C. W. B. Maxwell*). UNITED STATES: Alaska, Livengood Rd. 6 miles, 1 ♂, 11.v.1951 (*J. M. Geary*); N. Colo., 1 ♀, 4.iii.98 (*no collector*); Minn., Two Harbors, 2 ♂, 14.viii.37 (*R. H. Beamer*); Minn., Aitkin, 1 ♂, 25.viii.33 (*P. B. Lawson*); Ia., Ames, Exp. Sta., 7 ♀, 12.v.97, 2 ♂, 4 ♀, 25.v.97, 1 ♀, 14.x.96, 1 ♀, 16.v.98 (*no collector*), 1 ♂, 21.vii.97 (*H. Osborn*); Ia., Ames, 1 ♀, 9.iv.08 (*R. I. W.*), 1 ♀, 23.iv.1924 (*no collector*), 1 ♀, 2.v.1947 (*J. Laffoon*), 1 ♀, 7.v.1951 (*U. L. Forney*), 1 ♀, 3.v.1952 (*W. Kwolek*); Ia., Boone Co., Ledges St. Pk., 1 ♀, 6.v.1958 (*D. H. Munger*); Ia., Mt. Pleasant, 1 ♀, 1.v.1933 (*C. Hall*), 1 ♀, 25.iv.1934 (*Knutson*); Wis., Fish Creek, 2 ♂, 14/24.viii.1926 (*P. B. Lawson*); Wis., St. Croix Falls, 6 ♀, 15.viii.16 (*J. G. Sanders*), 2 ♀, 15.viii.16 (*D. M. DeLong*); Wis., Marshfield, 3 ♀, 20.viii.16 (*D. M. DeLong*); Wis., Ladysmith, 2 ♀, 9.viii.16 (*D. M. DeLong*); Wis., Racine Co., 1 ♀, 19.v.1954 (*D. H. Habeck*); Wis., Bayfield, 1 ♀, 10.ix.16 (*D. M. DeLong*); Wis., Merrillan, 1 ♀, 5.viii.16 (*D. M. DeLong*); Wis., Amery, 1 ♀, 10.vi.17 (*E. D. Ball*); Wis., Madison, 1 ♀, 21.ix.17 (*E. D. Ball*); Mich., Douglas Lake, 2 ♂, 22.viii.37 (*R. H. Beamer*); Mich., 1 ♀, no date (*no collector*); Mich., Cedar River, 1 ♂, 26.viii.37 (*R. H. Beamer*); Mich., Gogebic, 1 ♂, 18.viii.37 (*R. H. Beamer*); Mich., Livingston Co., E. S. George Reserve, 1 ♂, 1 ♀,

24.v.1939, 1 ♂, 7.x.1937 (*I. J. Cantrall*); Mich., Washtenaw Co., Ann Arbor, 1 ♀, 20.v.1937 (*D. L. Cantrall*); Ohio, Barberton, 2 ♂, 23.vii.36 (*L. J. Lipovsky*); Pa., Tyrone, 1 ♂, 2 ♀, 26.vii.17 (*J. G. Sanders*); Pa., Kane, 1 ♀, 2.viii.19, 1 ♀, 23.viii.19 (*D. M. DeLong*); Pa., Landisburg, 1 ♀, 4.vii.18 (*J. G. Sanders*); Pa., Hartstown Bg., 1 ♂, 26.vi.19, 1 ♀, 12.viii.19, 2 ♀, 14.ix.19 (*D. M. DeLong*), 1 ♀, 12.viii.19, 1 ♀, 13.viii.19 (*Mrs. DeLong*); Pa., Ohio Pl., 1 ♀, 20.vii.19 (*D. M. DeLong*); Pa., N.E., 1 ♂, 24.vi.19 (*Mrs. DeLong*); Pa., Presque I., 1 ♀, 29.viii.19, 1 ♀, 21.vii.20 (*D. M. DeLong*), 5 ♀, 7.ix.20 (*J. G. Sanders*); Pa., Port Matilda, 1 ♀, 24.viii.18 (*J. G. Sanders*); Pa., Sta. College, 1 ♀, 25.vii.17 (*J. G. Sanders*); Pa., Greenfield, 1 ♀, 22.viii.20 (*D. M. DeLong*); Pa., Richfield, 1 ♀, 26.vii.18 (*J. G. Sanders*); N. Y., Fredonia, 2 ♂, 21.vii.46 (*L. D. Beamer*); N. Y., Cranberry Lake, 1 ♀, 19.vii.17 (*C. J. Drake*); Conn., Storrs, 1 ♂, 1 ♀, 9.viii.46 (*L. R. Penner*); Mass., Boston, Arnold Arboretum, 1 ♀, no date, (*no collector*); N. H., Bretton Woods, 1 ♂, 31.viii.34 (*R. H. Beamer*); Maine, Ft. Kent, 1 ♀, 28.viii.13 (*H. Osborn*).

New Records: Alaska, New Brunswick, Saskatchewan, Massachusetts.

The type series of *D. mali*, located in the Provancher Collection in Laval University, Quebec[5], was not studied. Van Duzee (1912*b*), in his study of the Provancher Collection, placed *D. communis* Gillette as a synonym of *D. mali*.

Part of the type series of *D. communis* Gillette, located in the U.S. National Museum, and consisting of 1 ♀ labelled[6] " 17904 " " Type " " Type No. 3415 U.S.N.M.", one specimen with abdomen missing labelled " Ithaca, N.Y., 31 July '94 " " Type " " Type No. 3415 U.S.N.M.", 1 ♀ labelled " Ag. Coll. Mich. 5–20 '92 168 " " Type " " Type No. 3415 U.S.N.M.", 1 ♀ labelled " Ag. Coll. Mich. 149 " "Collection C. F. Baker " " Type ", 1 ♀ labelled " Ag. Coll. Mich. 586 " " Collection C. F. Baker " " Type " " Dicraneura communis Gill." and 1 ♂ labelled " Ag. Coll. Mich. 205 " " Type " " Collection C. F. Baker " was studied. A further ♂ specimen of the type series labelled " 14873 " " Gillette Det. '95 4139 " " Type " " Type Dicraneura communis Gill." " Dikraneura communis Gill. Det. W. L. McAtee " " Paratype ♂ Dicraneura communis Gill.", located in the Illinois Natural History Survey Collection, was also studied. Of the above syntypes, the male labelled " Ag. Coll. Mich. 205 " " Type " " Collection C. F. Baker " is here designated as LECTOTYPE. It is located in the U.S. National Museum. The remaining specimens listed above are here designated as PARALECTOTYPES.

Gillette (1898*c*) in a list of original types of species in the Collections of the Colorado Agricultural College and Agricultural Experiment Station, lists 2 ♀ and 1 ♂ of *Dicraneura communis* Gillette. These specimens were not studied.

Biology. *Dikraneura mali* is a common species found from early spring to late summer. Its earliest recorded occurrence is during April in Illinois (Gillette, 1898*a*), Michigan (Gillette, 1898*a*), Connecticut (DeLong, 1923*a*), British Columbia (Downes, 1919*a*, 1927*a*), Ohio (Johnson, 1935*a*) and Minnesota (Medler, 1943*a*). This month is indicated also in specimens at hand from Iowa and Ontario, the earliest however

[5] Dr. R. Béigue, in correspondence.

[6] The information between quotation marks is contained on one label, the number of quotations indicating the number of labels.

being March in Colorado. The latest date recorded is September in Connecticut (DeLong, 1923*a*) and South Dakota (Severin, 1921*c*). Present specimens indicate this month also in Saskatchewan, Ontario, Wisconsin and Pennsylvania, the latest however being October in Iowa and Michigan.

It has been recorded on grass (Gillette, 1898*a*; Osborn, 1915*a*; DeLong, 1923*a*, *b*; Osborn, 1922*c*, 1928*b*; Medler, 1943*a*; Procter, 1946*a*; DeLong, 1948*a*; Phillips, 1951*a*), rye (Gillette, 1898*a*), oats (Osborn, 1915*a*), grain (DeLong, 1923*a*; Procter, 1946*a*), potatoes (Pettit, 1922*a*), apple trees (Provancher, 1890*a*) and willow catkins (Procter, 1946*a*). It is commonly found in meadows (DeLong, 1923*a*, *b*; Osborn, 1922*c*, 1928*b*; Procter, 1946*a*; DeLong, 1948*a*). Osborn (1928*b*) records its preference in Ohio for blue-grass pastures especially where somewhat shady. DeLong (1923*b*) in an ecological study of Presque Isle, Pennsylvania, found it present in wet meadows in the lagoon-marsh-thicket-forest succession and considered it to be restricted to this habitat. Osborn (1915*a*) likewise found it inhabiting grass near the tide water or salt marshes at Portland, Maine. In the prairie community of Central Canada it is apparently a sub-influent of minor importance (Bird, 1930*a*).

It has been considered of economic importance on oats and grass in Maine (Osborn, 1915*a*) as well as a common pasture and grain pest throughout the spring and summer in this state (Procter, 1946*a*). DeLong (1923*a*) likewise considers it a common pasture and meadow pest throughout the spring and summer in Connecticut. When feeding, it produces very conspicuous external symptoms in the form of small whitish spots on the foliage (Putman, 1941*a*).

Remarks. *Dikraneura mali* shows slight individual variation in the dorsal flexure of the apical region of the aedeagal shaft although the majority of specimens throughout the entire geographical range are as shown in Text-fig. 448. Certain specimens however show a more pronounced curvature, the extreme being shown in Text-fig. 449. Two specimens from Manitoba also lacked the anterior projection on the shaft (Text-fig. 450).

D. mali is distinct from all other species in the genus in the shape of the aedeagus. The absence of pygofer processes is seen in only one other species, *D. robusta* Lawson, although a comparison of the rest of the genitalia indicates that this condition has been independently acquired in both cases. The affinities of *D. mali* within the genus are not evident.

Dikraneura denticulata sp. n.

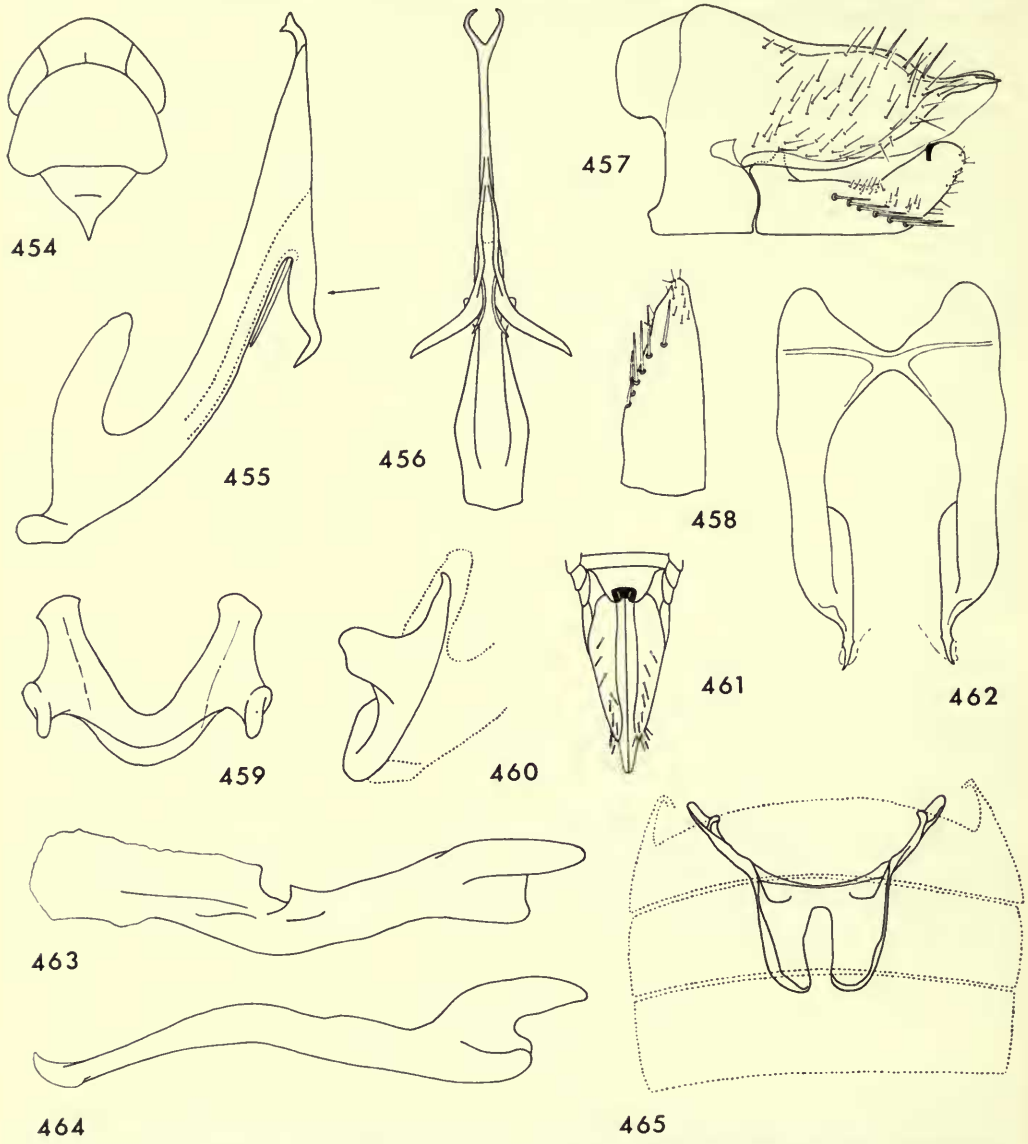
(Text-figs. 454–465)

Length: ♂ 4·34–4·40 mm. (mean 4·37 mm.). ♀ 4·28–4·44 mm. (mean 4·32 mm.).

Head with width slightly narrower than that of pronotum, vertex only slightly produced with apex broadly rounded in dorsal aspect, medial length $1\frac{1}{4}$–$1\frac{1}{3}$ times length next eyes, broadly rounded to face with latter slightly longer than wide, ocellocular area equal in width to antennal fossa; pronotum with width increasing posteriorly.

Colour of head yellow, orange-yellow or light orange-brown, paling over genae and vertex to yellowish cream, eyes testaceous. Pronotum with disc orange-yellow, lateral borders cream marked with yellow; scutellum yellowish, a narrow medial diffuse stripe over vertex, pronotum and scutellum pale whitish cream, often broader in female especially over disc of pronotum;

remainder of thorax with dorsum dark brown, venter pale stramineous washed with yellow. Legs pale stramineous washed basally with yellow. Fore wings with basal area subhyaline greenish yellow, internal edge of clavus and claval sutuie whitish; apical half hyaline, faintly



FIGS. 454–465. *Dikraneura denticulata* sp. n. 454, head, pronotum and scutellum, dorsal view; 455, aedeagus, left lateral view; 456, aedeagus, posterior view in direction of arrow in fig. 455; 457, male pygofer, valve and subgenital plate, left lateral view; 458, left subgenital plate, ventral view; 459, connective, anterodorsal view; 460, connective, left lateral view; 461, female genitalia, ventral view; 462, male pygofer, dorsal view; 463, left style, dorsal view; 464, left style, left lateral view; 465, abdominal apodemes, dorsal view. Scale as in figs. 1–16.

smoked with brown, veins yellowish. Hind wings hyaline, veins dark brown. Abdomen with dorsum dark brown to black with lateral edge in female cream or yellow, venter yellow; male pygofer and anal tube black, former paling ventrally and latter apically to cream, valve and subgenital plates concolorous cream; female pygofer pale yellowish or cream with dorsum and apex of ovipositor beyond pygofer dark brown, sternum VII cream with medial emargination brown.

Male apodemes elongate, each with length approximately twice width, lateral margin curving dorsally to a height subequal to width, extending to anterior region of fifth segment.

Male genitalia with pygofer tapering posteriorly in lateral aspect and terminating in a short acute posteriorly directed process; distal half of dorsomesal margin produced ventromesally; dorsolateral margin with a row of long spine-like setae along distal one-third; lateral surface with long hair-like setae over posterior two-thirds. Subgenital plates with apical two-fifths turned abruptly dorsoposteriorly and a small heavily sclerotized tooth subapically on dorsolateral margin; a uniseriate row of long spine-like setae along medial third of ventrolateral margin to base of upturned sector with a series of short hair-like setae along ventrolateral margin of latter; lateral surface devoid of setae except over medial area. Aedeagus with preatrium very short; basal apodeme moderately developed, elongate, directed dorsally; shaft elongate, laterally compressed, directed dorsally, tapering towards apex over distal third and terminating in a pair of short anterodorsally directed processes, their apices turned mesad and slightly bifid; a pair of stout elongate processes posteriorly approximately one-third distance from apex, diverging ventrolaterally, their apices turned anteroventrally; a pair of thin needle-like processes at base of posterior processes, between latter and shaft, closely applied and parallel to shaft with their apices slightly divergent; gonopore on posterior margin immediately distad of larger pair of posterior processes.

Female genitalia with sternum VII tapering posteriorly to narrow, concave, posterior margin, the base of the concavity truncate and slightly raised above level of sides in ventral aspect, the edges of concavity heavily sclerotized.

Holotype ♂. EAST NEPAL: Taplejung Distr., Sangu, *c.* 6,200′, 25/28.x.1961 (*R. L. Coe*), in British Museum (N. H.).

Allotype ♀. EAST NEPAL: Taplejung Distr., Sangu, *c.* 6,200′, 16/29.x.1961 (*R. L. Coe*), in British Museum (N. H.).

Paratypes. 2 ♀, same data as holotype, in British Museum (N. H.); 1 ♀, same data as allotype, in British Museum (N. H.); EAST NEPAL: Taplejung Distr., Sangu, *c.* 6,500′, 1 ♂, 1 ♀, 17.x/1.xi.1961 (*R. L. Coe*), in British Museum (N. H.).

Biology. Known only from East Nepal, *Dikraneura denticulata* was collected in October and November in a mixed forest at 6,200′–6,500′. Two females were taken at this locality in October from yellow blooms of cultivated Compositae.

Remarks. *Dikraneura denticulata* is unique from all other species of the genus in the possession of a sclerotized tooth on the subgenital plates as well as the general shape of the latter. It is also unique in the shape of the male pygofer and aedeagus as well as the female VIIth sternum. In general appearance, the aedeagus is similar to that of *D. dreisbachi* sp. n. while the presence of the two pairs of posterior processes near the midlength of the shaft is found in only one other species, *D. stonei* Ruppel & DeLong. In view of the other differences between *D. denticulata* and these species, and the fact that they are found only in Mexico whilst *D. denticulata* occurs in East Nepal, suggests that these similarities are due to convergence rather than indicative of any close relationship.

Apart from *D. variata* Hardy which occurs throughout the whole of the Palaearctic region, *D. denticulata* is the only member of the genus known from this area of the world. However, the area is relatively little known as regards the Cicadellidae and it is very likely that many more species will be found to occur. The unique subgenital plates of *D. denticulata* suggest a new genus although until our knowledge of this region is increased, it is included in the present genus.

SUMMARY AND CONCLUSIONS

The genus *Dikraneura* consists of thirty-three species and is predominantly Nearctic in distribution with only three species, *D. variata* Hardy, *D. aridella* (Sahlberg) and *D. denticulata* sp. n., occuring in the Palaearctic region. Two major groups, separated on the basis of the male genitalia, each with several species-complexes, can be recognized.

TABLE 1.

Species-groups and complexes within the genus *Dikraneura*.

Group I	Group II
Group Ia	
" *variata*-complex "	" *serrata*-complex "
variata Hardy	*vittata* Borland
carneola (Stål)	*serrata* DeLong & Caldwell
absenta DeLong & Caldwell	*beameri* Borland
aridella (Sahlberg)	*jalapensis* sp. n.
omani sp. n.	*dreisbachi* sp. n.
shoshone DeLong & Caldwell	*halberda* Ruppel & DeLong
ossia Beirne	*stonei* Ruppel & DeLong
hungerfordi Lawson	" *angustata*-complex "
" *abnormis*-complex "	*angustata* Ball & DeLong
abnormis (Walsh)	*torta* DeLong & Caldwell
etiolata sp. n.	*arcta* Ruppel & DeLong
urbana Ball & DeLong	" *ardea*-complex "
	ardea Ruppel & DeLong
Group Ib	
rubrala DeLong & Caldwell	
arizona DeLong & Caldwell	
triangulata sp. n.	
latacephala Beamer	
ungulata Beamer	
Group Ic	
" *rufula*-complex "	
rufula Gillette	
retusa Beamer	
rubica DeLong & Caldwell	

The largest of these groups (Group I), consisting of nineteen species, is characterized by the pygofer processes being recurved dorsolaterally and devoid of teeth

or additional processes along their length. The aedeagus terminates in a pair of posteriorly directed processes with a pair of additional anteriorly directed processes arising laterally or posterolaterally at varying positions on the shaft. The latter processes are rarely dorsally directed and occasionally absent while the terminal ones are rarely subapical. The group is Nearctic in distribution with the exception of *D. aridella* (Sahlberg) which is restricted to Europe and *D. variata* Hardy which occurs in both the Palaearctic and the north-west region of North America. The group may be subdivided, on the basis of the male pygofer, into those with a conspicuous dorsal convexity at the base of the posterior process (Group Ia), those without a convexity at the base of the process (Group Ib) and those with the posterior process itself reduced (Group Ic).

The larger of these subdivisions (Group Ia) consists of two species-complexes, the "*variata*-complex" of eight species, entirely western and northern in distribution but with *D. variata* Hardy and *D. aridella* (Sahlberg) occurring in the Palaearctic region, and the "*abnormis*-complex" of three species which is more eastern in distribution. Both these species-complexes are distinguished by the shape of the aedeagus, the former having a pair of simple apical processes and the latter having the apical processes branched or of two pairs.

The smaller of the subdivisions (Group Ic) contains only one species-complex, the "*rufula*-complex", consisting of three closely related species characterized by the reduction of the pygofer processes. This group is western and south-western in distribution.

The remaining subdivision (Group Ib), possessing the elongate processes of Group Ia but without a dorsal convexity at their base, is of a more heterogeneous nature than the preceding two subdivisions and shows certain characters in common with both. No distinct species-complexes are apparent and their treatment as one group is for convenience rather than an implication of natural affinity between the included species. *D. rubrala* DeLong & Caldwell is closely related to the "*variata*-complex", having the general aedeagal structure and short abdominal apodemes typical of the latter and should perhaps be included in that group. *D. arizona* DeLong & Caldwell is unique in the possession of a detached sclerite located dorsomesad at the base of the pygofer process which is a possible remnant of the dorsal expansion found in the "*variata*-complex". The aedeagal structure is typical of the latter group yet the abdominal apodemes are much larger. The former of these species is north-eastern in distribution and the latter south-western. The remaining three species of this sub-division, *D. latacephala* Beamer, *D. ungulata* Beamer and *D. triangulata* sp. n., are restricted to Colorado, Arizona and Mexico respectively and are of more doubtful affinities. The aedeagus of the two former species is similar to that of the "*rufula*-complex" in the possession of a medial spine at the apex of the posterior margin of the aedeagus but differ greatly in the shape of the pygofer. Both *D. latacephala* and *D. triangulata* also differ from the majority of species in the genus by the absence of a well produced, angulate vertex and the possession of a wide ocellocular area. These two characters are found in only one other species, *D. robusta* Lawson, also found in the south-west but distinguished by the absence of pygofer processes and the unique shape of its aedeagus. *D. triangulata* differs

further by the possession of straight dorsally directed pygofer processes and subapical rather than apical processes on the aedeagus.

The second major group within the genus (Group II) consists of eleven species characterized by the pygofer processes being recurved antero- or dorsomesally with teeth or additional processes along their length. The aedeagus is inclined more posteriorly and is without posteriorly directed apical processes in the majority of species although a pair of anteriorly or ventrally directed processes near the midlength of the shaft is still present. Unlike Group I, it is predominantly Mexican. Three main species-complexes may be recognized.

The largest of these, the " *serrata*-complex ", consists of seven species characterized by a laterally compressed aedeagus with anteriorly or ventrally directed processes arising from the posterior margin near its midlength and with paired apical processes absent or only weakly developed. The group is restricted to Mexico with only one species, *D. serrata* DeLong & Caldwell, occurring also in Arizona.

The next largest, the " *angustata*-complex ", consists of three very closely related species, distinguished from the preceding group, to which it is closely related, by a more cylindrical aedeagus, the presence of lateral rather than posterior midshaft processes and the possession of a pair of anteriorly directed flap-like apical processes (except possibly in *D. arcta* DeLong & Caldwell). Unlike the " *serrata*-complex ", this is more widespread, *D. angustata* Ball & DeLong itself occurring over the entire eastern half of the United States from Ontario to Mexico. The other two species, however, are more restricted and are found only in Arizona.

The third and last, the " *ardea*-complex ", contains only the species *D. ardea* Ruppel & DeLong. It is unique in that the aedeagus is S-shaped and terminates in a pair of elongate ventrally directed processes, the lateral midshaft processes being modified into a pair of short triangular flap-like processes which extend along a major portion of the shaft. Like the majority of species in the " *serrata*-complex ", it is confined to Mexico.

Of these three species-complexes the " *serrata*-complex " is the one most closely related to Group I. In the species *D. vittata* Borland the teeth are absent or represented rarely by only a single one at the base of the pygofer process while the processes themselves are elongate rather than robust and strongly recurved as in the majority of the other species. The basal apodeme of the aedeagus is also very similar to that seen in Group I rather than in species of its own group.

The remaining members of the genus, *D. robusta* Lawson, *D. mali* (Provancher) and *D. denticulata* sp. n., are distinct from one another as well as from other species of the genus and their affinities among the latter are uncertain. Both *D. mali* and *D. robusta* lack posterior processes on the pygofer although this has undoubtedly been arrived at independently as can be seen from the other components of the genitalia. The head of *D. robusta*, in particular the width of the ocellocular area, is similar to that of *D. latacephala* Beamer and *D. triangulata* sp.n., as mentioned earlier, and all three species are restricted to the south-west area of the Nearctic region. The structure of the genitalia, however, would again suggest this to be an independent development in all three cases rather than an indication of a natural affinity between them. Unlike *D. robusta*, *D. mali* is a widespread species found

throughout the northern half of the region. The species *D. denticulata* shows characters of both pygofer and subgenital plates which are unique within the genus, as also is the VIIth sternite in the female. The general appearance of the aedeagus is similar to that of *D. dreisbachi* sp. n., whilst the two pairs of processes on the posterior margin near its midlength is found in only one other species, *D. stonei* Ruppel & DeLong, both these species occurring in the " *serrata*-complex " and being found only in Mexico. Other pecularities of the male and female genitalia and its restriction to East Nepal, suggests the similarity to be due to convergence rather than indicative of a close relationship.

From this overall picture of the genus, its species-complexes and their geographical distribution, it is now possible to suggest probable zoogeographical stages in its evolution. The close relationship between the species *D. aridella* (Sahlberg), *D. variata* Hardy, *D. carneola* (Stål) and *D. absenta* DeLong & Caldwell, and their distribution over the Palaearctic or western Nearctic region, indicates a movement across the Bering Straits in either an easterly or westerly direction. The fact that *D. variata*, the only species common to both areas, is of rare occurrence in the Nearactic region and also highly variable in the latter indicating an unstable genotype, suggests that the Nearctic populations are at the fringe of the species range rather than a viable source of emigrants towards the Palaearctic. An easterly movement across the Bering Straits is therefore indicated. The large number of species in the Nearctic region as compared with the Palaearctic suggests that once present within the New World, the group underwent an initial period of speciation giving rise to the majority of species now found throughout the United States and Canada. A second period of speciation later appears to have occurred in Mexico giving rise to those species of which the majority are currently restricted to this area. The unique nature and widespread occurrence of many of the species present within the United States as compared to the more uniform appearance and restricted distribution of the Mexican species indicates a more recent origin of the latter and supports the hypothesis of a north–south movement over the continent. Subsequent to this second period of speciation, only one species, *D. angustata* Ball & DeLong, has so far been successful in moving north in competition with the previously established species of the region. It is of interest that it is found only over the eastern half of the region rather than the west where the majority of the Nearctic species are found, indicating a possible inability to compete with these species. Further support for this movement into and then out of Mexico is furnished by the fact that *D. vittata* Borland, which as we have seen is the most closely related of the Mexican species to the major Nearctic group, is found only in Mexico. *D. angustata* on the other hand is further removed morphologically from the major Nearctic group and is unlikely to have evolved from the latter and then entered Mexico to have given rise to *D. vittata* and related species.

REFERENCES

The full citation of all references up to 1955 are given in Metcalf (1964) except for additions and corrections to this work.

BEAMER, R. H. 1945. A new species of *Dikraneura* from Arizona. *J. Kans. ent. Soc.* **18** : 83–84, fig. 1.

BEIRNE, B. P. 1956. Leafhoppers (Homoptera: Cicadellidae) of Canada and Alaska. *Can. Ent.* **88** (Suppl. 2) : 1–180, figs. 1–1277.

DELONG, D. M. 1944. Nomenclatorial notes on Cicadellidae. *Ohio J. Sci.* **44** : 272.

DELONG, D. M. & KNULL, D. J. 1945. Check List of the Cicadellidae (Homoptera) of America, North of Mexico. *Grad. Sch. Stud. Ohio St. Univ. biol. Sci. Ser.* **1** : 1–102.

EDWARDS, J. 1890. Homoptera, pp. 11–16. *In* SAUNDERS, E. & EDWARDS, J., *Catalogue of British Hemiptera.* 16 pp. T. M. M'Gregor, Perth.

—— 1908. Homoptera, pp. 11–16. *In* SAUNDERS, E. & EDWARDS, J., *Catalogue of British Hemiptera.* 16 pp. Milne, Tannahill and Methuen, Perth.

HORN, W. 1926. Uber den Verbleib der entomologischen Sammlungen der Welt (ein Beitrag zur Geschichte der Entomo-Museologie). *Supplta ent.* **12** : 1–133, 1 portr.

HOWARD, L. O. 1930. A History of Applied Entomology. (Somewhat Anecdotal). *Smithson. misc. Collns* **84** : 1–viii, 1–564, pls. 1–51.

KNIGHT, W. J. 1965. Techniques for use in the identification of leafhoppers (Homoptera: Cicadellidae). *Entomologist's Gaz.* **16** : 129–136, figs. 1–3.

KONTKANEN, P. 1948. Beiträge zur Kenntnis der Zikadenfauna Finnlands. III. *Suom. hyönt. Aikak.* **14** : 85–97, figs. 1–6.

METCALF, Z. P. 1946. The center of origin theory. *J. Elisha Mitchell scient. Soc.* **62** : 149–175, pls. 23–41.

—— 1964. *General Catalogue of the Homoptera.* Fasc. VI. Cicadelloidea. Bibliography of the Cicadelloidea (Homoptera: Auchenorhyncha). U.S. Department of Agriculture, Washington, D.C. 349 pp.

OSSIANNILSSON, F., RUSSEL, L. M. & WEBER, H. 1956. Homoptera, pp. 148–158, figs. 183–199. *In* TUXEN, S. L. (ed.), *Taxonomist's Glossary of Genitalia in Insects.* 284 pp., 215 figs. Ejnar Munksgaard, Copenhagen.

SINGH–PRUTHI, H. 1929. Homologies of the genitalia of insects. *Entomologist's mon. Mag.* **65** : 198–201.

TROLLE, L. 1966. Nye danske cikader (Hemiptera, Cicadellidae). *Flora Fauna, Silkeborg* **72** : 93–100, figs. 1–17.

VILBASTE, J. 1965. *Über die Zikadenfauna Altais.* (In Russian with German summary). Institute of Zoology and Botany. Estonian Academy of Sciences. Tartu. 143 pp., 91 figs., 18 tables.

YOUNG, D. A. 1949. A preliminary list of Kentucky Cicadellidae (Homoptera). *Trans. Ky Acad. Sci.* **13** : 54–67.

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(Synonyms in *italics*)